THE Petroleum Engineer

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Meetings

California Natural Gasoline Association—December 5, Richfield Building, Los Angeles.

•

Mid-Continent Oil and Gas Association, Annual Meeting Board of Directors—December 10 (Tentative), Tulsa, Oklahoma.

•

American Association of Petroleum Geologists, 21st. Annual Meeting—March 19, 20, and 21, Tulsa, Oklahoma.

•

American Chemical Society, Petroleum Division, Symposium on Motor Fuels—April 13-17, Kansas City, Mo.

•

Oil Equipment and Engineering Exposition—April 20, 21, 22, 23, 24, and 25, Houston, Texas.

•

Natural Gasoline Association of America, Annual Meeting—May 13, 14, and 15, Mayo Hotel, Tulsa, Oklahoma.

•

International Petroleum Exposition—May 16-23, 1936, Tulsa, Oklahoma.

•

Pennsylvania Crude Oil Association, Annual Meeting—June 18 and 19, State College, Pennsylvania.

•

Canadian Gas Association, Annual Meeting—July 8, 9, and 10, Vancouver, British Columbia.

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The Course of Oil

By K. C. SCLATER

Water-Flooding May Be Tried in Texas Field

A revival of interest in secondary recovery methods is evident. Many repressuring projects whose operations were suspended now are active. Most significant, however, is the increasing interest in water-flooding. From the growing attention observed in this particular secondary method of recovery it is quite probable that the near future will witness the beginning of several water-flooding projects in the Mid-Continent and Texas fields.

One large producing company in Texas has just filed an application with the Railroad Commission for a hearing on certain leases in Brown County. In the application it is stated that the oil sand in this lease is practically depleted. The company wants to experiment with the lease by flooding the oil sand with water to determine whether or not such character of operation is profitable and whether or not the ultimate recovery will be more than it would be under ordinary operating conditions.

On the outcome of this experiment—should permission be granted by the Railroad Commission to carry it out—may hinge the beginning of other water-flooding operations in Texas where the subsurface conditions are favorable.

Technical Research in Natural Gas

Completion of two technical research projects of eminent practical value to the natural gas industry has just been announced by the American Gas Association at its annual meeting held in Chicago last month. Involving as they do exhaustive technical researches that have been in progress for several years, the results will be the subject of comprehensive reports soon to be published.

One of the projects concerns the gauging of gas wells without recourse to open-flow methods. Reliable methods have been evolved whereby gas wells now may be gauged accurately by pressure observations at the well head with the well producing at different rates of flow and without the necessity of opening the well to atmosphere. Although these or similar methods of gauging wells already are in use in some parts of the country the completion of this project by the American Gas Association has some significance, for the general adoption of the approved practice of gauging wells as developed by this research will mean a substantial contribution to the conservation of natural gas resources. It has long been recognized that the gauging of gas wells by open-flow methods constitutes a flagrant waste of natural gas that could be obviated by applying more advanced engineering principles.

The other project has to do with gas measurement through orifice meters. Standard methods and constants for the measurement of gas through orifice meters have been developed by technical research. As a result, more precise methods of measuring gas flow by orifice meter now are available to the industry.

Bringing to successful completion of this research work and reducing the results to practical application is an achievement in technical progress of which the American Gas Association can justly be proud.

Estimating Developed Reserves

Current engineering thought on methods of estimating developed reserves of petroleum occupied a prominent place on the program of the Fall Meeting of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers at Houston, Texas, last month. From the several papers presented it is evident that petroleum engineers are alive to the importance of the various factors entering into estimates of reserves.

Proration and curtailment has been responsible for many changes in both field practice and production technology. Old methods of estimating reserves by means of natural production decline curves are falling into disuse. They are no longer adaptable to present-day field practice. Decline curves of wells or fields whose natural rate of flow is restricted have little meaning. New and more scientific methods of estimating reserves have had to be developed.

Petroleum engineers have many more facilities and much more knowledge at their command than were available before proration became the vogue. They now are able to make accurate bottom-hole measurements by means of which can be studied the physical changes that occur in the reservoir as oil and gas are produced. Valuable data are thus being accumulated and technique in the application of these data to the solution of reservoir problems has been undergoing rapid development. Skill in this direction is even now evident in the analyses of reservoir conditions that have been made in several fields, with respect to oil, gas, and energy content, particularly East Texas and Conroe. Predictions, based on bottom-hole data, on the trend in reservoir conditions in these fields with regard to reservoir energy and probable reservoir content of oil and gas are somewhat of a revelation in how close they are being fulfilled in actual practice.

Such studies in oil and gas production data for the estimation of oil and gas reserves include also investigations of the properties of oil-gas mixtures. A knowledge of their behaviour under the high pressures found in deep fields is essential. As new facts on the behaviour of oil and gas under high pressures are uncovered so will the accuracy of estimates of developed reserves increase.

Knowledge of this kind is fundamental to a solution of many problems of production, prominent among which are two crying for solution on tangible evidence, namely, economical well-spacing and optimum rate of production. Both are related to the estimation of developed reserves of oil and gas.

« « « HIGHLIGHTS IN OILDOM » » »

Oklahoma City Wilcox Potential Declines

Three hundred and five Wilcox zone wells in the Oklahoma City field have been given new potentials, aggregating 242,984.25 bbl. daily for the group, compared with 414,558.60 bbl. for the April period, a decline of 41.39 percent. Oil and gas conservation records show that 12 new wells have a combined daily potential of 43,906.26 bbl., which offsets a part of the natural decline in the older parts of the field.

The 201 wells upon which open flow gauges were taken showed a new daily potential of 194,077.76 bbl., compared with 258,599.34 bbl. in April, a decline of 24.95 percent. The 104 wells that took production tests dropped in total potentials from 155,959.26 bbl. in April to 48,906.49 bbl. for the October period.

●

Gain Shown in Natural Gasoline Output

Official figures of the United States Bureau of Mines show an eight percent increase in natural gasoline production in 1934 compared with 1933. The increase was due principally to the marked increase in operations at stripper plants in the Panhandle of Texas and to the increase in the capacity of plants in the East Texas field.

For the entire nation the 1934 production was 1,535,360,000 gal., while for 1933 it was 1,420,000,000 gallons. The year witnessed a further increase in the relative importance of the absorption process and a further decrease in production at compression and charcoal plants, the report said.

The total value of the 1934 output was $60,523,000, an average of 3.9 cents per gallon. Although the average was 0.1 cent higher than in 1933, this increase does not adequately measure the improvement in natural gasoline markets in 1934, it was pointed out, as it reflects the low quotations of midyear. The average price of a representative grade of natural gasoline was 3.50 cents per gal. on January 1, 1934, fell to 1.25 cents by midyear, but was 3.75 cents, or three times the low, on December 31.

●

Drop in East Texas Potentials

Potential producing capacity of the East Texas field has declined approximately 25 percent in the last year and a half, according to the Texas Railroad Commission.

Recent tests on 43 key wells indicate a potential producing capacity of 10,000,000 bbl. per hour for the field, compared with 14,000,000 bbl. per hour a year and a half ago. Gordon Griffin, chief engineer for the commission, states that the decrease is due to the new method of computing and taking the tests, and to the fact that some wells on which the high potential had been based have shown declines in producing capacity.

The tests were ordered after some operators objected that existing allowables were based on out-of-date potential figures.

Connally Act Held Valid

Federal Judge Randolph Bryant recently filed a decision at Tyler, Texas, holding the Connally oil act valid. A verbal decision had been given several weeks previously at Sherman, Texas, in cases of the East Texas Refining Company vs. the Federal Tender Board. The decision filed at Tyler was in written form.

In finding the Connally act valid, Judge Bryant stated that the purpose of the act was to prohibit the shipment in interstate or foreign commerce of oil or oil products produced, transported, or withdrawn from storage in violation of state laws and regulations. Provisions of the act apply to oil produced or on hand prior to February 22, 1935.

"The burden of proof to show petroleum or products thereof is eligible for shipment in interstate commerce is upon the applicant for a state tender," Judge Bryant said.

●

Crude Prices Up in California and Pennsylvania

Crude oil prices made a recent advance in both the Pennsylvania and California areas. The Pennsylvania hike, amounting to 15 cents per bbl. on all grades, was attributed to the booming market for bright stock. Latest quotations on Pennsylvania grade crude are as follows: Southwest, $1.87; Eureka, $1.82; Buckeye, $1.67; and Bradford, $2.15.

In California two of the major purchasing companies advanced prices on an average of 55 cents per bbl. to a level five cents higher than was in effect prior to the last cut.

●

Gas Waste Orders Rescinded

The Texas Railroad Commission has rescinded its Panhandle gas waste orders, giving as its reason the pending litigation attacking validity of the gas waste law. The commission's order reads as follows:

"Whereas, on the 17th day of October, the Commission issued an order entitled 'Special order fixing allowable production of sweet and sour gas in the Panhandle District of Texas', and

"Whereas, certain court proceedings are now pending which have the effect of temporarily suspending further enforcement or attempts to enforce House Bill 266 passed at the regular session . . . insofar as the Panhandle is concerned:

"Now, therefore, it is ordered that said order of October 17th as above described is hereby abrogated and withdrawn and that the status which existed prior to the promulgation of said order of October 17th shall obtain and exist until further ordered by the Commission."

This means that all control over the gas field is removed; and that the Commisison's gas-oil ratio orders for the oil wells in the field are repealed, inasmuch as they were carried forward in the gas order rather than in the general proration order.

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PROGRESS OF MAJOR PIPE LINE WORK

THE Skelly Oil Company recently announced plans for the extension of its pipe line system into Western Kansas. The company, which has purchased a part of the old Central Kansas Pipe Line Company's 6-in. line from Burrton to Lyons, proposes to lay a 6-in. line from the latter point to the Lorraine pool of Ellsworth County. This probably will be a forerunner of a line to the Russell County area. The Skelly Oil Company has developed considerable production in the Lorraine pool, as well as in Russell County.

With the construction of the Skelly line the Western Kansas area will be served by the Stanolind, Sinclair-Prairie, Standish (Phillips), White Eagle, Kaw, and Skelly.

Construction of additional pipe line facilities should be a boon to drilling activity in the area. Heretofore many fields in Russell, Ellis, and Trego counties either were without an outlet or had their production sharply restricted due to lack of pipe lines.

●

The White Eagle Division of the Socony-Vacuum Oil Company has started construction of an 8-in. pipe line from Burrton, Reno County, to Chase, Rice County, Kansas, a distance of 40 miles. The Truman-Smith Construction Company of Eldorado, Kansas, has been awarded the contract.

The White Eagle line will be the eastern portion of an 8-in. line extending into Western Kansas. The Kaw Pipe Line Company (Phillips, Texas, and Empire) will lay the western portion of the line, totaling 65 miles. Jones & Brooks of Oklahoma City, Oklahoma, are the contractors for the latter. More detailed information on this project will be found on page 32 of this issue of *The Petroleum Engineer*.

When completed the Kaw Pipe Line Company's artery and that of the White Eagle will connect at Burrton, providing another outlet for Western Kansas crude oil. The two lines, which will be operated jointly, are expected to be completed and ready for operation by January 1, 1936.

●

The Derby Oil Company has completed 8½ miles of 4-in. pipe line in Kansas. A line was laid from the Burrton pool to the Haynes Brothers' No. 1 Mueller, two miles northwest of Haven in Reno County. From that point the company extended the line to the A. M. Miller well at Yoder, which has established a new pool. The latter is owned by the Derby Oil Company and the McPherson Drilling Company.

●

The Canadian Western Natural Gas, Light, Heat and Power Company of Calgary, Alberta, Canada, has been doing considerable reconditioning work on its lines during the mild season of the year and this work has now been completed. That portion of the line running through irrigated districts of Alberta was found to have suffered the most from corrosion, due to the action of the water on the pipe. In spite of this fact, however, the pipe through the irrigated farming district near Coaldale, which was replaced with new and reconditioned stock, had been in the ground since 1912.

●

The Phillips Petroleum Company's 24-in. gas trunk line from the northeastern part of Moore County to the Phillips camp at Borger, Texas, has been completed, and 16-in. lateral lines are being laid to connect with various gas fields in the area. Laterals to the wells will be of 12-in. and 16-in. pipe. The lines are being welded.

●

Construction of the 140-mile 8-in. welded pipe line from the Crystal field of Michigan to Toledo, Ohio, is under way. The line is being laid for the Simrall Pipe Line Company in conjunction with the Standard Oil Company of Ohio.

The general contractor is the Franklin Tool Company of Mt. Pleasant, Michigan. Working with Gene Harper and J. W. C. McKee of that firm, are J. F. Wilson, pipe line superintendent for the Standard of Ohio, and Delbert Hewitt, superintendent of the pipe line construction division of the Simrall Pipe Line Company. It is expected that the line will be completed by about December 1.

●

A 26-mile 6-in. welded oil line is being laid for the Texas Pipe Line Company between the Lafitte field of Jefferson Parish, Louisiana, and Marrero, just south of New Orleans. The Apex Construction Company of Houston, Texas, is in charge of the work. The line is expected to be in operation by December 1.

●

The Illinois Pipe Line Company has completed a 10-mile oil line from the Medicine Bow field in Carbon County, Wyoming, to Medicine Bow. The line consists of two parallel 4-in. lines and a single 6-in. line. Loading racks and a 10,000-bbl. storage tank have been constructed at the terminus of the line.

●

The Keystone Pipe Line Company's 165-mile 6-in. gasoline carrier, extending its line from a point near Mechanicsburg, Pennsylvania, to Pittsburgh, has been completed. The Keystone is a subsidiary of the Atlantic Refining Company and handles gasoline produced by the latter's refinery near Philadelphia. The Marathon Construction Corporation of Dallas, Texas, was the general contractor on the project.

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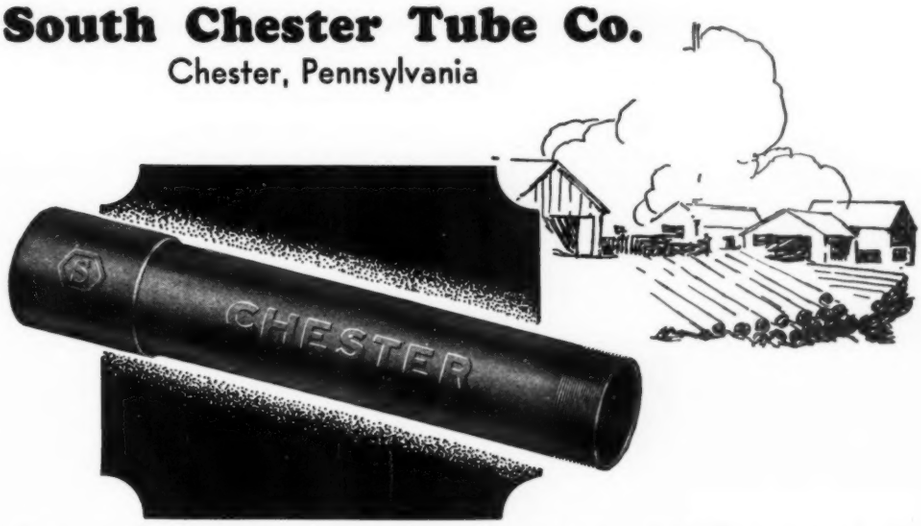

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LATEST ACTIVITIES IN THE OIL FIELDS

WHAT many oil men are terming the state's most sensational strike in several years was the blowing in wild on October 24 of the Carter Oil Company and Associates' No. 1 Ruth Williams well in the old Fox field of Carter County in southern Oklahoma. Since 1912 there has been production from 2000 to 3000 ft. in the field. The Williams well is producing from what is believed to be the Simpson-Wilcox horizon at a total depth of 8088 feet.

After flowing wild for a week the well finally was brought under control when 20 tons of heavy mud were forced into the hole. The flow of oil had been running an estimated 10,000 bbl. per day.

The field had been on stripper production for some time when leaseholders decided to go together and drill a deep test as a community proposition. It is believed that, as a result of the success of this test, many old fields in Carter and Stephens counties may be redrilled.

●

Successful completion of the Sterling Oil and Refining Corporation's No. 1 Janik Heirs, a rank wildcat test in northeast Wharton County, Texas, is being looked upon as an important discovery. The well blew in making gas and much distillate from a depth of 7867-79 feet. The pool opener is two miles northwest of East Bernard and approximately 42 miles southwest of Houston. It is on a block of 11,000 acres assembled early in the year after a reflection seismograph survey had revealed a deep structure.

●

A shallow oil pool has been discovered in the Price district, Archuleta County, Colorado. The William E. Hughes Fee No. 2, which has been producing 300 bbl. per day on swabbing tests, is being put on the pump. Its total depth is 1120 ft., and production is from the Tocito member of the Mancos shale.

A new oil pool looms for Central Michigan. Recently the King Drilling Company's No. 1 Kube in Saginaw County was brought in at a total depth of 2738 ft. in the Traverse lime. On a two-day test it produced approximately 1000 bbl. of crude. The wildcat is about 11 miles southeast of the Porter oil field.

●

The Shell Petroleum Corporation and associates have opened a new pool near the town of Lerado in Reno County, Kansas, with their No. 1 Reese. The test is producing from the Viola lime at a total depth of 4156 feet. Initially it made 896 bbl. of oil in 24 hours.

●

Approximately 1200 acres will be added to the Sundance area in the Lance Creek field of Wyoming if the Huber Oil Company's No. 1 Jose is successfully completed as a producing well. The test cored saturated Sundance from 4024 to 4042 ft., and was drilled to 4096 ft. in the redbeds, where it was waiting on casing at the last report.

●

Gatchell 28-7, wildcat test of the Continental Oil Company, on the South Dome of Kettleman Hills, California, has been abandoned. Drilled to a total depth of 7849 ft., this test penetrated several horizons that gave promise of commercial production, but none materialized. At 7766 ft. the last test was made, resulting only in the production of hot salt water.

●

Reagan County, Texas, is the scene of a wildcat strike by the Sun Oil Company that gives promise of opening commercial production from the dolomite lime zone in the southeastern part of that county. The wildcat, No. 1 L. Young Wilson, was drilled to a total depth of 2444 ft., and the hole filled 1500 ft. with 24 gravity oil after being shot with nitroglycerine. The well is approximately 13 miles southeast of the Big Lake field.

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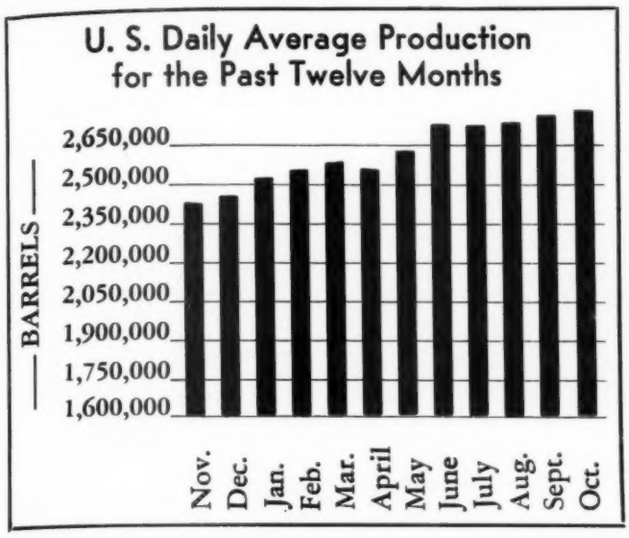
Colorado	1.00	Ohio	
New Mexico	.75	Lima	1.30
Texas		Michigan	1.02
North Central	.95	Pennsylvania	
Panhandle	.51-.71	Bradford	2.15
West Texas	.70-75	Southwest	1.87
Gulf Coast	1.04	Eureka	1.82
Darst Creek	.87	Buckeye	1.67
East Texas	1.00	Corning	1.32
Kansas	1.00	West Virginia	1.67
Oklahoma	1.00	Canada	2.10-2.17
Arkansas	.70		

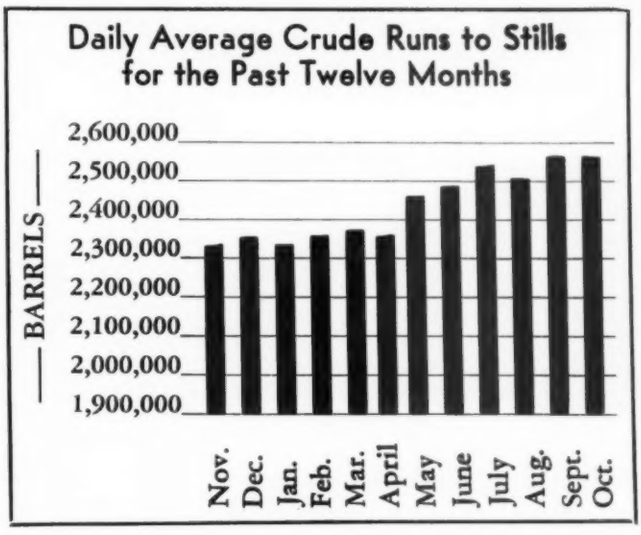
DAILY AVERAGE CRUDE OIL PRODUCTION

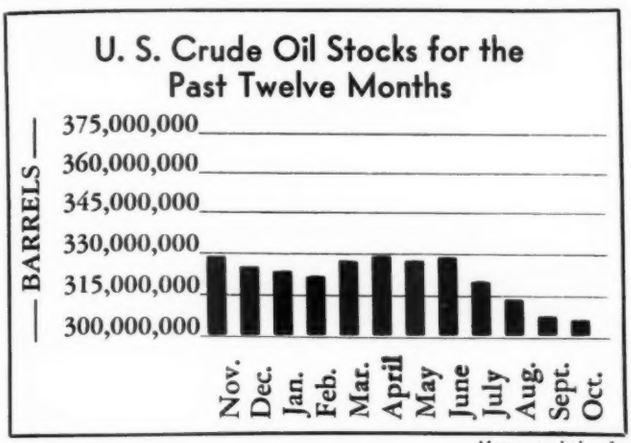
Furnished by A.P.I.

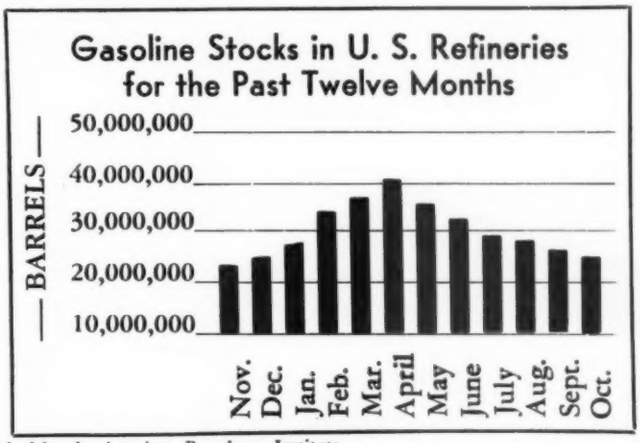
(Figures in Barrels)

	B. of M. Dept. of Interior Calculations Oct. 1	Week Ended Oct. 26 1935	Week Ended Sept. 28, 1935	Week Ended Oct. 27 1934
Oklahoma	492,900	499,900	492,150	439,550
Kansas	146,100	150,950	147,550	124,750
Panhandle Texas		56,050	55,550	58,800
North Texas		59,050	59,000	57,100
West Central Texas		25,550	25,600	27,550
West Texas		155,450	155,050	138,400
East Central Texas		45,950	47,200	42,850
East Texas		428,250	444,800	403,300
Southwest Texas		60,900	60,600	58,650
Coastal Texas		193,350	194,000	162,000
TOTAL TEXAS	1,025,500	1,024,550	1,041,800	948,650
North Louisiana		32,100	27,800	23,900
Coastal Louisiana		124,850	121,350	76,700
TOTAL LOUISIANA	125,100	156,950	149,150	100,600
Arkansas	29,200	30,150	30,250	30,700
Eastern	98,100	106,250	104,750	105,050
Michigan	39,500	54,500	52,500	30,700
Wyoming	34,300	40,800	37,750	33,800
Montana	11,000	12,850	13,050	11,350
Colorado	4,200	4,400	4,900	3,050
New Mexico	50,600	56,950	56,250	45,550
TOTAL EAST OF CALIF.	2,056,500	2,138,250	2,130,100	1,837,750
California	497,700	659,700	633,100	462,300
TOTAL UNITED STATES	2,554,200	2,797,950	2,763,200	2,336,050









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for October, 1935

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	234	228	66	120	3600	2	40	Rotary
Duval County	44	37	10	17	2300	2	22	Rotary
Archer County	39	21	2	14	660–1800	1 or 2	40	Rot.-Cab.
Conroe	1	1	1	2	2000–7400	3 or 4	40	Rotary
Panhandle	53	50	35	119	2200–3900	2	40	Rotary
Refugio County	6	5	1	2	5200	2	38	Rotary
Oklahoma								
Oklahoma City	20	16	4	43	6500	3	39	Rotary
Pontotoc County	31	26	5	51	1800–4488	2 or 3	38	Rotary
Osage County	19	14	11	42	380–2850	2	37.5–40	Rot.-Cab.
Kansas								
McPherson County	9	6	1	8	2900–4300	2	38	Rot.-Cab.
Harvey County	5	3	0	6	3450	2 or 4	37	Rot.-Cab.
Ellsworth Arch	46	29	18	79	3300	4	37	Rot.-Cab.
California								
Kettleman Hills	4	4	2	24	8300	3 or 4	40	Rotary
Long Beach	13	13	3	44	7000	3	36	Rotary

Field Activities by States for October, 1935

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1934 (In Barrels)
	October	September	October	September	October	September	October	September	October	September	
Arkansas	9	6	3	2	5	11	11	9	27	33	11,412,100
California	82	65	69	61	74	68	73	110	261	258	175,678,362
Colorado	1	....	1	....	....	....	4	2	27	32	1,168,000
Illinois	....	....	....	....	....	....	0	14	8	9	4,466,000
Indiana	12	21	1	5	....	....	1	2	50	33	813,000
Kansas	114	115	78	78	84	105	29	30	207	199	45,577,050
Kentucky	15	18	11	16	....	....	4	8	12	11	4,863,000
Louisiana	49	60	32	34	59	61	46	35	132	139	32,572,900
Michigan	47	63	28	44	86	65	95	129	113	251	10,589,600
Mississippi	2	2	1	0	....	....	1	2	9	11	Gas Prod.
Montana	19	18	15	16	....	....	10	11	56	54	3,797,000
New Mexico	18	27	16	27	....	....	10	13	99	104	16,529,050
New York	....	....	....	....	....	....	0	0	6	3	3,880,700
Ohio	113	123	72	82	....	....	20	34	118	129	4,291,000
Oklahoma	211	192	141	126	184	189	54	51	527	504	176,506,550
Pennsylvania	11	12	11	10	....	....	23	29	97	115	15,353,850
Texas	788	846	609	631	882	1035	329	381	1056	1192	380,848,000
West Virginia	49	32	42	25	....	....	27	24	81	91	4,043,550
Wyoming	6	7	5	5	....	....	11	10	64	72	12,371,100
Total	1546	1607	1135	1162	1374	1534	748	894	2950	3240	903,350,812

THE MONTH'S ACTIVITIES IN REFINING

Percent Refinery Capacity Operated

Western Division, 64.7 percent **Central Division, 69.3 percent** **Eastern Division, 81.4 percent**

THE Big Goose refinery at Sheridan, Wyoming, has been purchased by D. O. Gray, president of the Gray Refinery, Inc., Newcastle, Wyoming. He will continue to operate the newly-acquired plant, as well as the one at Newcastle.

●

Danciger Refineries, Inc., operating a 10,000-bbl. skimming plant at Footes Switch, south of Longview in the East Texas field, is installing a modern cracking unit, it has been announced.

●

As a result of recent developments in the Ogemaw field of Michigan a new 1000-bbl. refinery is being planned for the area. Bay City capital is said to be backing the proposed project. According to reports a site has been obtained in West Branch and arrangements are being made with producers for crude supply.

●

The South Africa Torbanite Mining and Refining Company announces that deposits of torbanite at Ermelo, British South Africa, are rapidly being made available for commercial purposes. A retorting plant, comprising a first unit of two retorts with a capacity for treating 150 tons of torbanite per day, is being completed.

The company's refinery at Boksburg also is well on its way toward completion. This plant will process gasoline from crude oil.

●

The Breckenridge Gasoline Company has shut down its casinghead gasoline plant south of Breckenridge, Texas. The Hanlon Gasoline Company has taken over the connections and is running the gas to one of its plants in the area.

●

The State Refining Company has been organized at Grand Rapids, Michigan, by Earl T. and Roman F. Glocheski, Glen G. Blandford, and J. C. Harrington. The company has offices in the Houseman building, but, as yet, has not announced its plans. Incorporation is for $125,000.

The Natural Gasoline Corporation, organized as a subsidiary of the Warren Petroleum Company, Tulsa, Oklahoma, has purchased all the gasoline plants and equipment of the Amerada Petroleum Corporation of Oklahoma and Texas. Six plants in Oklahoma and one in Texas are involved. The transaction also includes all casinghead gas rights of the Amerada in the new Monument field, Lea County, New Mexico. It is announced that the Natural Gasoline Corporation is signing contracts with additional operators in that area and will erect a large gasoline plant in the field.

M. E. Mockley, general manager of the Natural Gasoline division of the Amerada Petroleum Corporation for the past 14 years, is vice-president in charge of operations of the new organization. Other officials of the company include W. K. Warren, president; J. A. LaFortune, vice-president; H. E. Felt, secretary; and A. J. Murphy, treasurer.

●

The Tyreco Refining Company, with headquarters at Arp, Texas, has purchased the 200-bbl. skimming plant of the Anarene Refining Company, northwest of Anarene in Archer County, Texas. Its daily capacity may be increased to 1000 bbl. later, it is stated.

●

The Pettus Refining Company has completed and placed in operation a 1000-bbl. topping plant at Mathis, Texas, in western Patricio County and due south of the Dinero and McNeill fields of Live Oak County. The owners are Morris Roberts, George Ray, Jr., and Robert Walton, all of Pettus.

●

The Chosen Sekiyu Kaisha (Chosen Petroleum Company) of Chosen, Japan, has been formed by a combination of Japanese financial interests headed by Jun Noguchi, president of the Chosen Nitrogenous Fertilizing Company. The new company has been licensed principally to engage in refining.

●

The Utah Refining Company, with a 3000-bbl. skimming plant at Kilgore, Texas, is considering the possibility of erecting a 1500-bbl. cracking unit in the near future.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending October 26, 1934

A. P. I. Figures

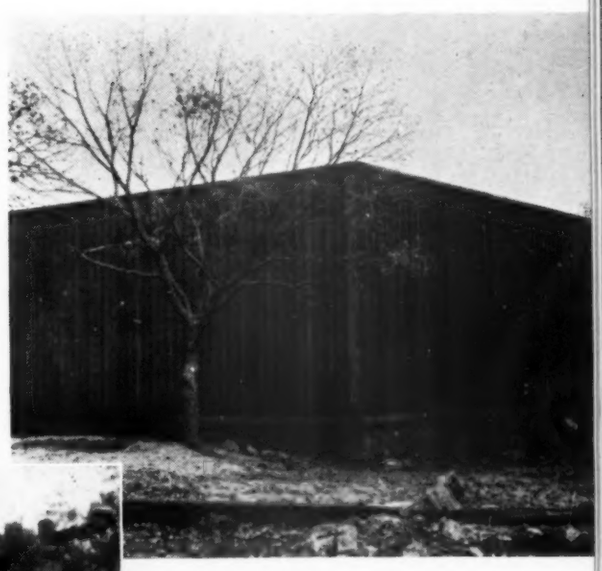
(Figures in Barrels of 42 Gallons Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	474,000	77.5	12,121	12,447
Appalachian	94.8	113,000	77.4	1,813	958
Ind., Ill., Ky.	95.9	379,000	89.4	7,372	4,263
Okla., Kans., Mo.	84.8	268,000	69.8	4,080	4,956
Inland Texas	48.5	86,000	53.8	954	1,499
Texas Gulf	96.4	531,000	89.2	4,691	12,066
La. Gulf	96.4	123,000	75.5	969	4,838
No. La.-Ark.	90.0	42,000	58.3	293	482
Rocky Mt.	61.9	38,000	63.3	550	793
California	92.6	521,000	66.0	8,320	65,933
TOTALS WEEK:					
Oct. 26, 1935	89.5	2,575,000	75.6	41,163	108,235
Oct. 19, 1935	89.5	2,552,000	74.9	41,799	107,918

Modern Controlled Water Flooding in Oklahoma

New project has modern facilities for water supply and treatment. Delayed flood type of water-drive on the five-spot plan adopted

By LEO H. TOWERS



Above: Treating tank in the open adjacent to building covering filter tank

Above: Outside view of the enclosed spray pond

Left: Connections at intake of water wells showing meter installed

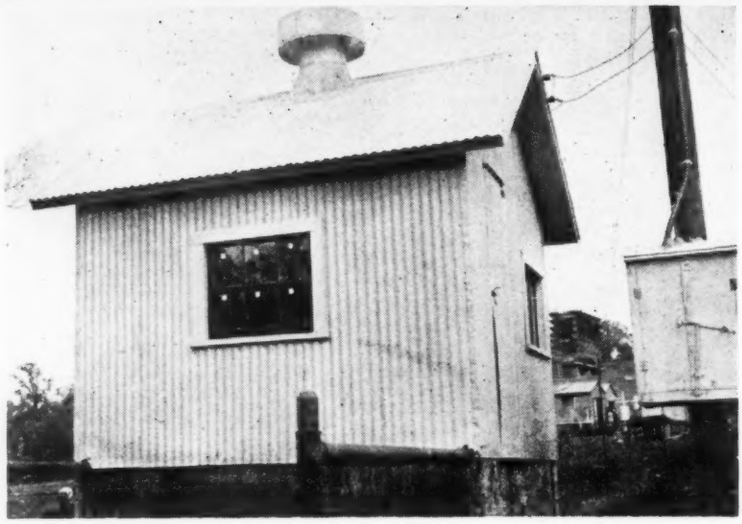
WATER-FLOODING as a means of increasing the recovery of oil from old producing fields has long been associated with the Eastern fields, particularly in the vicinity of Bradford, Pennsylvania. Success of this process in the east has led to its use in the Mid-Continent area in a few cases in the past four or five years. Recently additional operations have begun that have added new impetus to this plan of recovery in Oklahoma. In the Bradford field, after having recovered approximately 35 percent of the oil from the sand by natural flow and pumping, an additional 25 to 30 percent is being recovered by water-drive. While sand conditions vary somewhat from those of the Eastern fields there are certain fields in northern Oklahoma and southern Kansas where this water-drive should be fairly successful. Another variation of the Mid-Continent area from the Eastern fields is in the availability of sufficient water for the project. This promises to make the chief difference in modern Mid-Continent water-flooding practice.

The latest and most modern plant built in Oklahoma is the plant of the Forest Producing Company of Bradford, Pa. Situated two miles north of Codys Bluff in Nowata County, the plant is in the center of several thousand acres under lease by this company. Wells in this locality are among the oldest producers in the Mid-Continent field. Production had declined to that point where the time was ripe for the water-drive. The producing sand in this area is the Bartlesville, found at a depth of approximately 500 ft. and averaging in thickness from 40 to 50 feet.

Construction work on the treating plant started July 1 and the first water pressure was applied to the wells about October 10 of this year. While the treating plant was under construction the water supply well was drilled and the 45 water-drive wells on the 80 acres selected for the first part of the project were drilled.

Delayed 5-Spot Plan

All old wells on the lease are abandoned under this new development and all new wells are drilled on the five-spot plan. The name is derived from the method of spacing used at Bradford. Water wells are drilled at equal intervals over the entire lease and then the oil wells are drilled in the center of each set of four water wells making the five spots. This company has drilled the wells 330 ft. apart with the outside rows of water wells on the property line. Each oil well when drilled

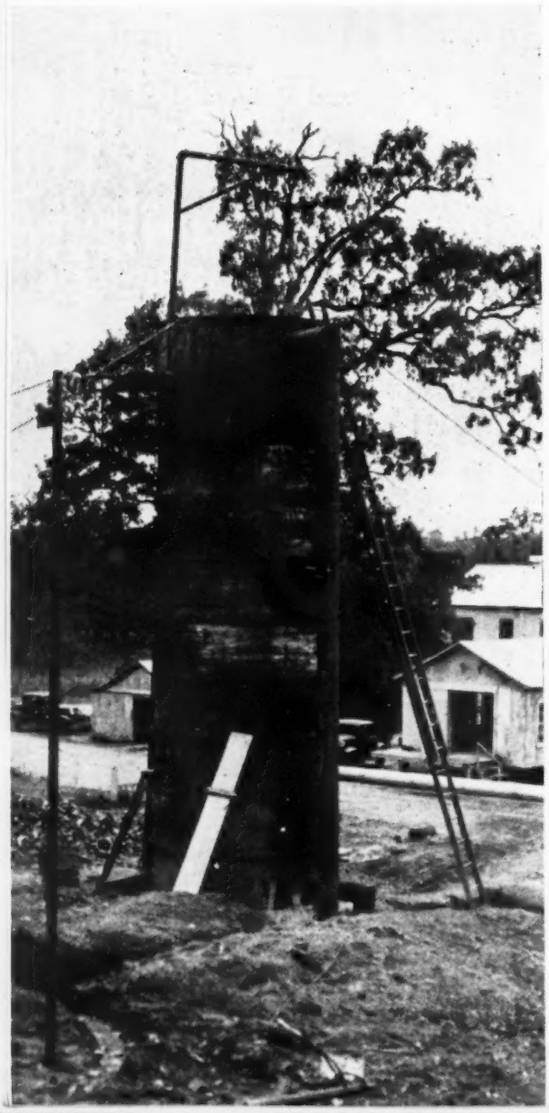


Close up of well house showing pipe supports for skidding house to one side when working on well

will then be in the center of a 2½-acre tract. Under the delayed plan of flooding the oil wells will not be drilled until sufficient pressure has been built up in the sand. This should take from 45 to 75 days. With operations under way on this portion of the project the adjoining 80 acres was drilled and water connections are being made to these wells. In this manner the water drive will be extended as operating conditions justify it.

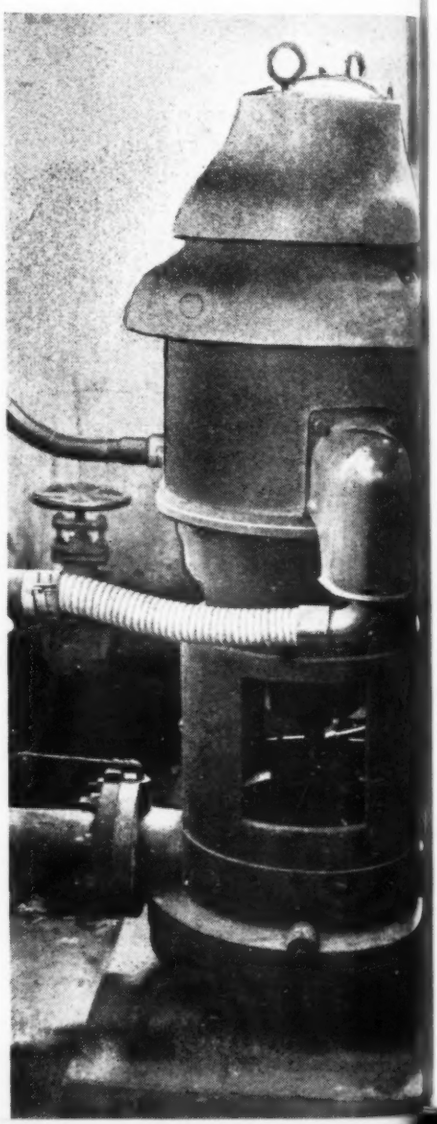
In locating the plant site advantage of the topography has been taken in placing equipment. Referring to the accompanying sketch the water supply well was located at the foot of a hill with the cooling tower at the crest. To insure sufficient water for the project a well was drilled through several shallow water sands to reach an ample source of supply at a depth of approximately 1500 feet. Although there is a plentiful supply of water its hydrogen sulphide content made water treatment a major problem in the development. Since pumping operations have begun, the sulphur odor is easily detected in the air before reaching the plant site.

For lifting the water from the well a Byron Jackson 9-stage deep well pump was installed. A General Electric, 20-hp. induction motor is direct-connected to the pump. Special fittings have been installed in the pump by the makers to resist chemical action by the impurities in the water. An automatic oiler insures proper lubrication of the pump. To protect the pump and motor a 10-ft. by 10-ft. house with roof ventilator has been built over the well. An ingenious device has been incorporated into the well house to expedite repairs to the pump and well. On top of the concrete foundation two pieces of 2-in. pipe are imbedded in the concrete at the ends of the house and parallel to the ends. The pipe extends beyond the side of the house a distance of 10 ft., where the free ends are anchored by vertical pipe supports. On the opposite side of the building a door was cut large enough to clear the well head. When it becomes necessary to work on the well the building is loosened from the foundation by the four corner bolts and the entire house slid back on the extended pipe, allowing free access to the well. Discharge from the pump is through a 6-in. line to the spray pond at the top of the hill.



Surrounding the large concrete spray pond is a fluted wooden wall eight ft. high to prevent loss of water by the wind. The fine spray nozzles dissipate much of the impure gas contained in the water.

About half-way down the hill on the gravity return line between the spray tower and the treating tank the water is put through a vertical scrubber. The water enters the scrubber at the top and after dropping through the wood and brick baffles is drawn off at the bottom. Air is forced from the bottom of the scrubber up through the water and discharges through the top into the air. This scrubber is set close to a compressor station already operating on the lease and the air blower connected to the scrubber is set in this compressor station and operated by belt drive from a gas engine. From here the water goes to the outside wooden treating tank. This tank is set adjacent to the two-story building housing the filter tank. From the second floor of this house comes steady streams of copper sulphate and sulphate of alumina. These chemicals are fed to the tank by automatic feeders, insuring the correct mixture at all times. From the mixing tank the water goes to the filter tank inside the building. In con-



Left: Scrubber for blowing air through water to remove hydrogen sulphide gas
Right: Hydropress pump in sump pit. Pump No. 2 is directly behind pump shown

View of plant site showing the water supply well house

Treating house is shown to the right of the well house

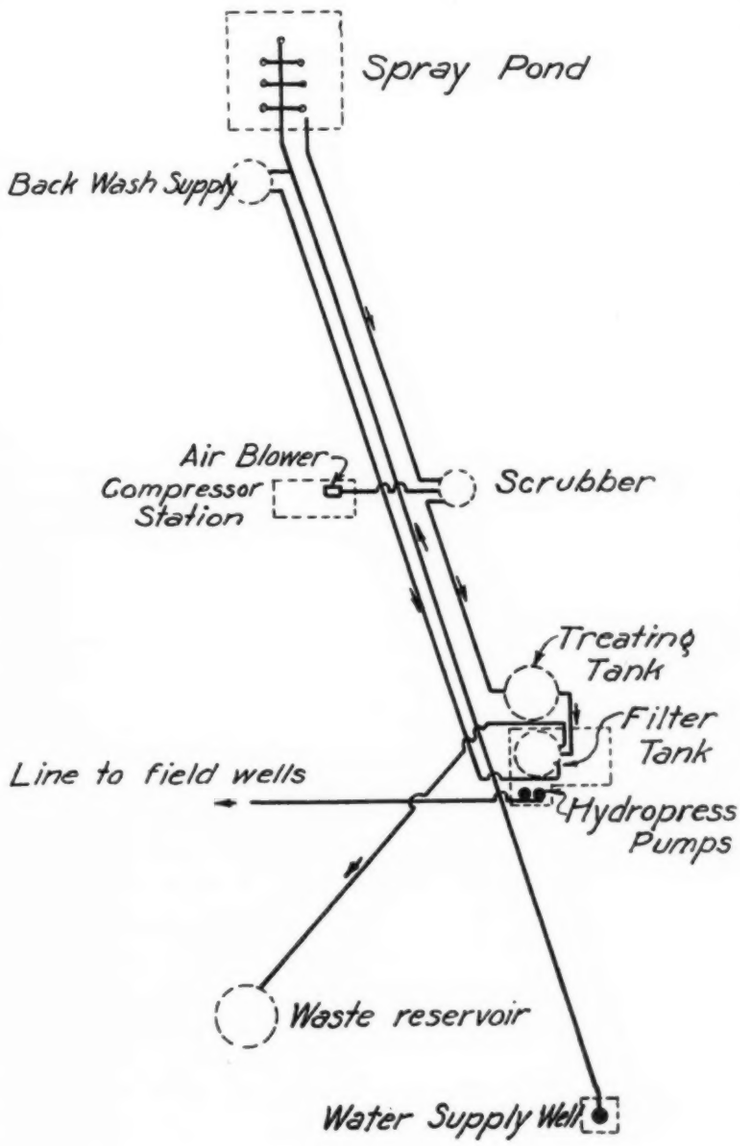
struction of the treating plant room was made and connections installed to allow for doubling the present size. Rate of flow of the water through the filter beds is controlled automatically by a new type "Rate of Flow Control Valve" manufactured by the Simplex Valve Meter Company. Filtered water is discharged into the clear well under the filter tank.

Filter beds are cleaned by backwashing. Long stem gate valves operated from the second floor, which is flush with the top of the filter tank, permit the operator to look into the tank as he operates the backwash. Water for the backwash comes from a storage tank near the spray pond and is filled from the spray pond line. Sufficient head is obtained to wash the filter beds properly and the waste wash-water is then discharged through a sewer line to a large tank in a low part of the plant site, whence it will be disposed of through proper drainage facilities.

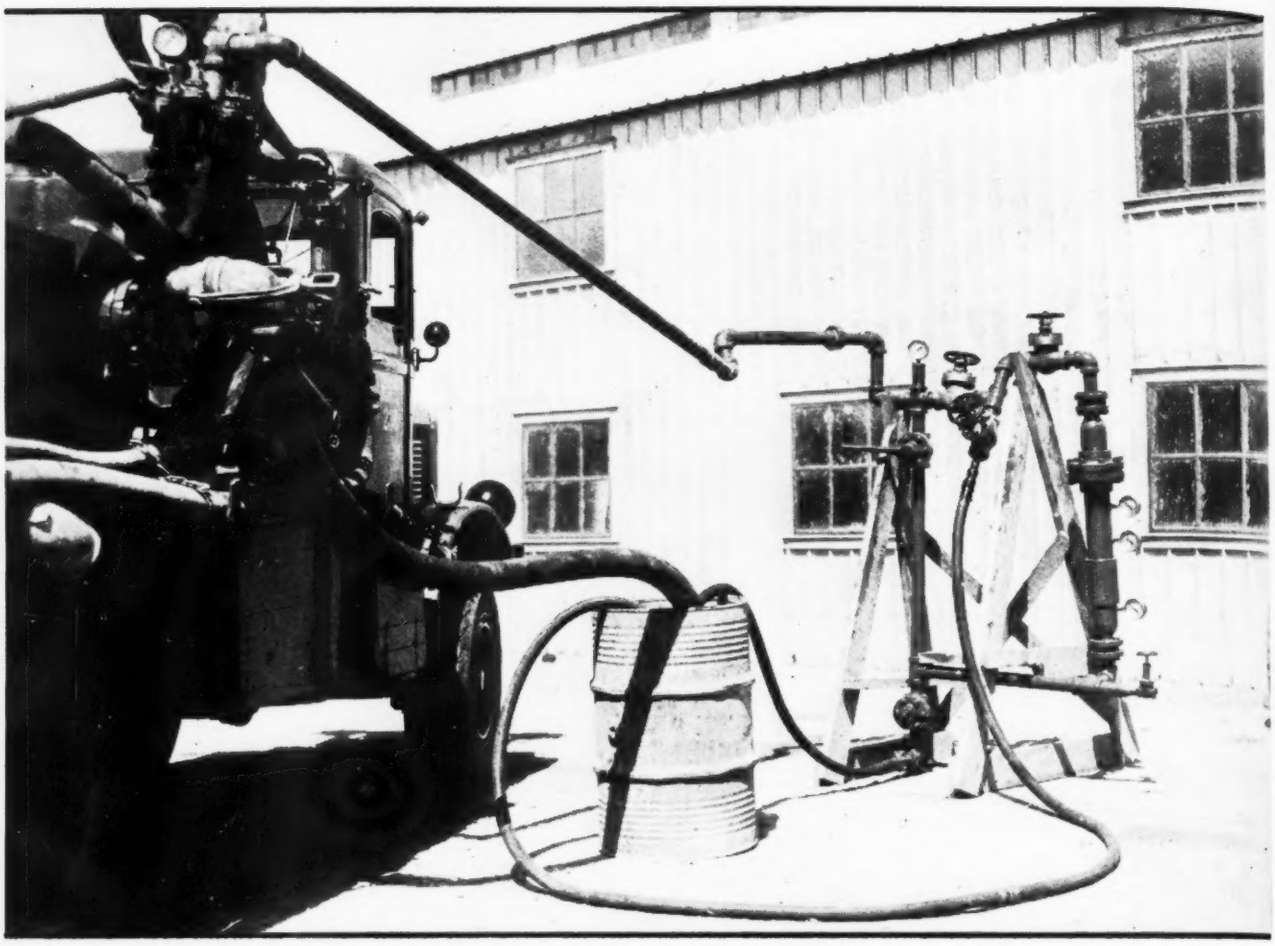
For pumping the purified water to the wells, two Byron Jackson 15-in. 8-stage Hydropress pumps direct-connected to General Electric 75-hp. induction motors have been installed in an offset to the treating house. These pumps are capable of supplying water to the wells at 500 lb. pressure. Each pump requires a floor space of less than two ft. square, and is placed in a sump on a level with the adjacent clear well. Starting switches, however, are on the main floor level. On the discharge line of the pumps is a domestic type water meter and also a recording pressure gauge.

From the pumps a 5-in. line carries the water to the lease on which the wells are located; 1½-in. lines are used from this header line to the individual wells. All field lines, as well as the well casing, is of National Tube Company lap-welded "Duroline" cement-lined pipe. At each well the line is reduced through high-pressure ½-in. brass fittings, where another water meter is set. After passing through the meter the line is again swaged to the well casing.

Operations of this company are being watched by other producers of stripper fields in the Mid-Continent area. In other areas if sufficient water can be obtained requiring less treatment, a plant as elaborate as that built by this company will not be needed. But under the conditions encountered this plant will stand as a model of modern water-flooding practice.



Sketch showing plant lines and general lay-out of equipment



Hook-up for making the experimental tests with fibrous materials in mud and cement. Sealing mixtures could be circulated and sealing pressures built up on the various formations used for the tests.

Fibrous Material in Cement and D of Cement or Mud Into Formati

DURING the past year considerable headway has been made in preventing the loss of circulating fluids or cement slurry into formations.

While the use of fibrous materials in drilling fluids is not necessarily a new practice in general, yet recent developments have produced more satisfactory results than previous methods. The use of pre-mixed self-sealing cement has also been developed. The new developments were brought about as the result of efforts to overcome the loss of mud and cement into formations while drilling or while cementing in the Fitts Pool at Ada, Oklahoma.

Considerable laboratory work was done during the past year with various fibrous materials and upon applying to the problem in the Fitts Pool, the very first well in which it was used, provided very successful results as follows:

The well had been drilled to 600 ft. and was losing a pit full of mud every two hours. The mud went out into some formation, or formations, and some of it was oozing from a creek bottom several hundred feet from the well. One ton of selected fibrous material was mixed with the 9 lb./gal. mud in the circulating pit. This mixture was circulated in the well with the result that the fibrous material was carried by the mud into the voids of the permeable formations and soon built up a seal. The mud quit oozing from the creek bottom and there was a loss of only six inches of mud in the circulating pit during the time the seal was being obtained. The hole was drilled to 675 ft., the point selected for setting 13⅜-in. casing, without further difficulty.

A second question remained in that job, however, and that was whether or not the seal already obtained against loss of drilling fluid would be sufficiently effective to allow the casing to be cemented from top to bottom without losing any cement slurry into the formations. The casing was run and cemented with regular cement slurry from top to bottom without any appreciable loss of slurry.

A similar condition exists at various deeper levels in the Fitts Pool. The use of selected fibrous materials was applied to deeper levels, with equally successful results. In some of these operations where it was not certain that a suitable seal had been built up during the drilling operation to prevent loss of cement slurry, it was considered advisable to mix fibrous materials with the cement, in order to make the

cement self-sealing. The fibrous materials were mixed with the dry cement at the cement plant for the purpose of both economy and facility when mixing it with water. This self-sealing type of cement was used on several deep strings in the Fitts Pool without any appreciable loss of returns at the surface during the cementing job. Previously there were a number of cases where returns were lost during the cementing job, indicating that some of the cement was going out into formations.

Due to the apparently successful results of these materials in the Fitts Pool, they were tried out in other areas in Oklahoma, Kansas, and the Texas Panhandle, and the results were equally successful. In Kansas a seismograph crew found the material that was being used in the Fitts Pool ideally suited for preventing loss of circulating fluid while drilling shallow holes in which they experienced loss of circulation from the surface down to approximately 175 feet.

Relative to obtaining a seal that will greatly improve the results in cementing "thirsty" formations, there are two general lines of thought. One of them is to obtain a seal while drilling through a "thirsty" formation that will be effective during the cementing operation; while the other line of thought is to use a self-sealing cement that will make its own seal in case the seal obtained while drilling becomes ineffective during the cementing operation.

With regard to obtaining a seal while drilling, this has usually been done whenever there is an appreciable loss of drilling fluid into some "thirsty" formation; however, there is a possibility of seals that have been made in the ordinary manner being broken down when the cement is being placed. Then there are cases where there would be no appreciable loss of drilling fluid during the drilling operation but yet when the cement slurry is being placed the seal is broken down and some of the cement goes out into a formation as indicated by loss of returns at the surface during the cementing operation. In order to overcome this condition there is an idea that is possible to carry out in a practical way, along the following lines:

Drilling Fluids to Prevent Loss . . .

By C. P. PARSONS

Vice President, Halliburton Oil Well Cementing Co., Duncan, Okla.

Loss of circulation is one of the most disquieting problems encountered in rotary drilling. How it was successfully overcome in the Fitts Pool, Oklahoma, by the use of fibrous materials is here described. In this instance, the selection and the method of using these materials with cement is a recent development based on considerable laboratory work.

While drilling a well in an area in which there are "thirsty" formations that cause trouble in cementing jobs, one could drill a short section of formations, say about 50 or 100 ft., then raise the drill stem until the bit is at the upper part of the section just drilled, close the blow-out preventer and apply pump pressure, say 1000 lb. per sq. in. or some pressure that it would be safe to assume would be ample for completing the cementing job that will be done later. This pressure can be applied either through the drill pipe or on the bradenhead in order to test the seal normally established by cement slurry when cementing. If the section of formation does not take mud under the pump pressure then release the pressure, lower the drill pipe and penetrate another section of formation and repeat the application of pump pressure. If, in any of these pressure applications, a formation starts taking fluid then a special batch of mud containing fibrous material can be pumped down through the drill pipe until the lower end of the special batch of mud reaches the bottom of the drill pipe, at which time the bradenhead is closed and the only place for the fiber to travel is into the "thirsty" formation. This special fibrous mud is pumped into the formation until a seal has been built up to withstand the required pump pressure. By repeating the successive pressure tests and sealing operations throughout any series of suspected formations, it is felt that there would be little chance for the loss of cement slurry during the cementing operation.

Following the other line of thought wherein the use of self-sealing cement may be used to prevent loss of cement slurry in a formation, it is best that such cement be in a pre-mixed form, mixed at the cement plant. This would be most economical and would facilitate mixing and handling at the well. Each sack of cement will contain a definite percentage of fibrous material calculated to be most effective for the purpose. This would also provide maximum uniformity in the distribution of the fibrous material.

Approximately 70,000 sacks of pre-mixed self-sealing "fibered" cement has already been successfully used. In the Oklahoma City field an operator was able to cut down the amount of cement used to cement casing from top to bottom by as much as 23 percent, using fibered cement. This operator reports that the average amount of plain cement required to cement 2000 ft. of 13⅜-in. had been 2600 sacks, whereas the average number of sacks of fibered cement was 2000. This operator also reported that while using an average of 350 sacks to cement 250 ft. of surface pipe, they averaged 300 sacks when using fibered cement.

Fibered cement has a practical application when plugging back in "thirsty" formations. For instance, in a recent well containing formations of this type it took 300 sacks of plain cement to plug-back 30 ft. of hole that had been cut by a 6⅛-in. bit. While there have been cases in which large wallows could account for this excess cement, such wallows being caused in unconsolidated formation by the hydraulicking effect of the circulating fluid through the drilling bit or by erosion while the well is being produced, yet in this case the excess cement required was thought to have gone into a "thirsty" formation at the bottom of the well.

There are three general methods for handling such a condition. One of them is to use regular cement slurry and make successive plug-back jobs using small amounts of slurry in each job and allowing an interval of several hours between each job. Another is to lighten the weight of the cement and increase its angle of repose by using a cement-bentonite mixture, placing it in small amounts in successive jobs. The third method is to use a self-sealing cement, which will build its own seal when the cement starts going out into the formation.

The Kaw Pipe Line Company Building in Western Kansas

THE recently organized Kaw Pipe Line Company is constructing an 8-in. oil line through the heart of the active western Kansas fields to serve a territory now lacking in pipe line facilities. The trunk line will start approximately four miles south of Russell in Russell County and run almost due southeast to Chase in Rice County, a distance of 50 miles. In addition to the main line the company will take over gathering lines now in operation along the route and connecting the present scattered fields.

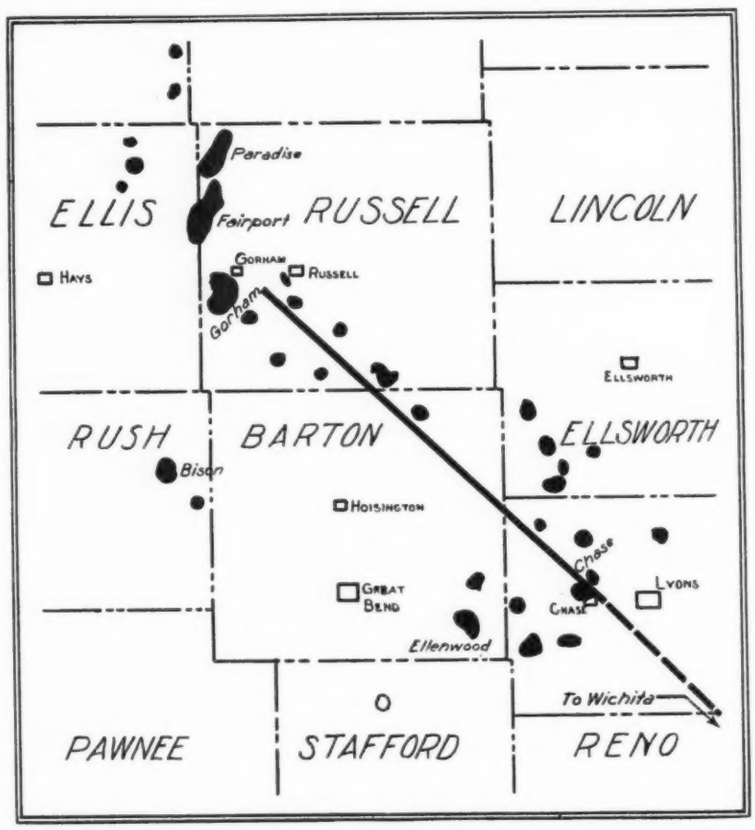
Pipe for the line is being salvaged from abandoned lines of the Texas Pipe Line Company and Empire Pipe Line Company in southern Oklahoma and northern Texas. A section of the Texas Pipe Line system between Wilson, Oklahoma, and Sherman, Texas, is being reclaimed by the J. R. Stewart Construction Company of Oklahoma City. This line was laid approximately 20 years ago and was one of the first lines of The Texas Company to have a protective coating applied. The Empire Company is reclaiming a part of their line between Healdton, Oklahoma, and Gainesville, Texas, the work being done by the Kelly-Dempsey Company of Tulsa. Both sections of line are threaded and coupled pipe. As the pipe is taken up by the contractors it is hauled to the conditioning shops where the threads and couplings are cut off and the ends beveled for welding. The pipe is then machine-cleaned and inspected for defects. Small pits are spot-welded but any badly pitted joints are cast aside. Serviceable pipe is given a primer coat of asphalt and racked ready for transportation. The conditioning plants will be moved from time to time as progress in taking up the line is made. So far very little pipe has been discarded as unserviceable and each contractor is able to rack a mile of pipe a day.

The Mid-West Construction Company of McPherson, Kansas, is trucking the pipe from the racks to the line in Kansas, a distance of 400 miles. Approximately two miles of pipe is trucked and strung along the right-of-way per day.

Re-laying of the line is being done by Jones & Brooks, Inc., of Oklahoma City. Construction started from the lower or Chase end of the line and is proceeding northwest. The terrain is almost a pipeliners' paradise so far as accessibility and levelness is concerned. Only one river crossing—the Smoky Hill River—will be required. Lindewelding will be used on the line. The route of the line has been tested for "hot spots," or unusual corrosive areas. At these points the pipe will be given a coat of pipe line enamel and felt-wrapped before lowering into position. Unless unusual weather is encountered the line should be completed by the middle of December.

Pump station plans are not yet completed but it is likely that only one station will be needed on the line.

The Kaw Pipe Line Company was formed by The Texas Company, the Phillips Petroleum Company, and the Empire Gas and Fuel Company. B. E. Hull of Houston is president; J. K. McGoldrick of Tulsa, vice-president and general manger, and E. F. Guidinger and F. K. Haskell, vice-presidents.



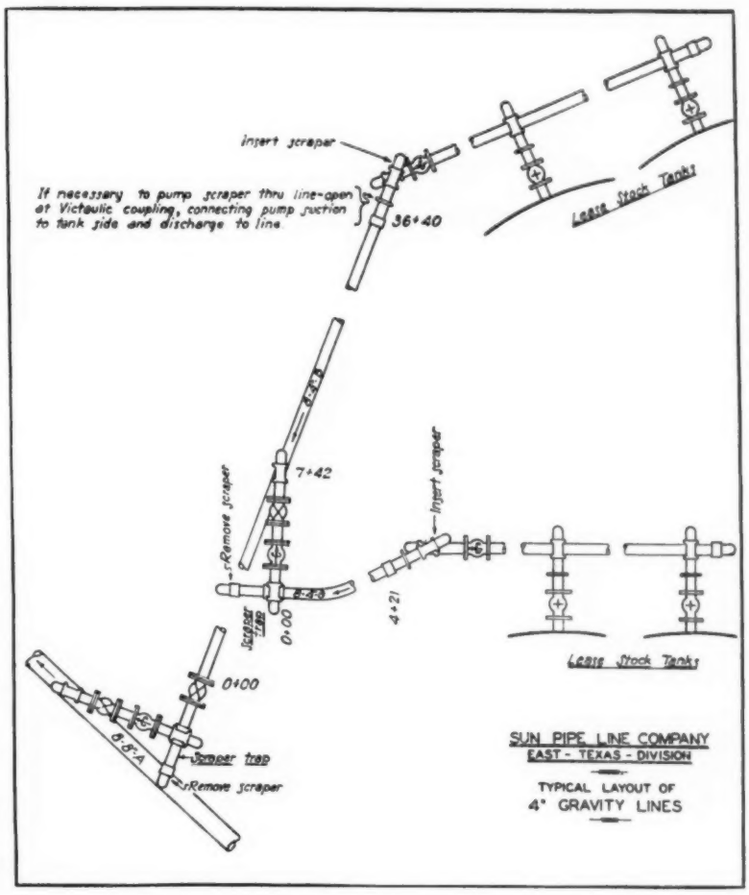
Sketch showing the route of the Kaw Pipe Line Company's 8-in. line and the fields it will serve.

Controlling Paraffin in East Texas Gathering Lines

By FRANK H. LOVE

Systematic use of line scrapers employed to remove deposits—Layout of lines at stations permits carrying out schedules of this work with greatest facility

Fig. 1



EAST Texas pipe line operators, troubled to some extent by paraffin accumulations in their gathering lines since the early days of the field, have seen a steady increase of such deposits within recent months. Perhaps the most marked increase was noted during the past winter, some pipe line companies being forced to remove twice the volume of paraffin from their system as during the same period of the previous year. This condition, naturally, has necessitated a periodic revision in the schedule of paraffin control operations. In the case of the main gravity lines, as well as a few chronic cases on the smaller diameter lines, scraper runs have had to be stepped up from four to eight runs annually.

Major pipe line companies have followed a definite program of paraffin control, revised as conditions demanded, since the beginning of the field. Pumping stations were constructed, and lines laid, originally in a manner best to facilitate this program. One company conforming to such a policy is the Sun Pipe Line Company. A recounting of the Sun's method of paraffin control in East Texas is of interest and value because, generally speaking, it is representative of the best practices followed throughout the field by all major pipe line companies.

The aim of the Sun Pipe Line Company has been to operate and maintain its gathering system free of paraffin accumulations in the most economical manner. Several indefinite factors have entered into the problem, an important one being the method used in flowing and cleaning wells. While no control can be exercised by the pipe line companies in that respect, regulation governing permissible height of stock tank bottoms has been a protection to some extent, but not entirely so, as considerable paraffin remains suspended in the oil and settles out in the lines. Other factors affecting paraffin accumulations are well allowables, weather, size of pipe, rate of flow, age of field, and condition of wells. Recently the greatest unit volume of paraffin has been gathered in areas where salt water intrusion has been recorded, principally along the west edge of the field.

The common practice adopted in East Texas for the elimination of paraffin from field lines is the regular use of line scrapers. In drafting its original construction plans, the Sun Pipe Line Company determined upon this method, and all lines and pump stations were constructed to permit scraper runs. Standard plans were drawn for tank battery headers, connections and tie-ins, both at pump stations and along the main gathering line, in order that scrapers could be run with the least possible interruption to regular operation, at the same time making it possible for the work to be handled by a small crew. Fig. 1 shows sketches of two typical 4-in. gravity lines, one long and the other short, revealing the manner of construction to permit scraper operation.

Headers at all key pumping stations are extended some distance beyond the limits of the station proper and into a concrete pit. The terminus of the gravity line, as well as that of the discharge line, is in this sump, making it possible for all lines and headers to be cleaned into it and the salvable oil recovered. Fig. 2 shows a typical electric pump station layout.

Since most check valves will not pass a scraper, and in order to simplify the runs, they are placed only on the tank battery headers, on the throws at tie-ins, or on the pump manifold.

A crew consisting of a foreman and two helpers is assigned to the work of removing paraffin from the lines. They cover the entire gathering system and initially spent full time on scraper work; however, in the spring of 1932, with the system in good condition, only 60 percent of their time was required. Since the spring of 1933, though, with the introduc-

tion of the 36-hour week, the crew has had to put in full time to maintain schedules.

Equipment required for the work consists of one 1½-ton truck; one 60-b. hp. hydraulic oil pump driven with a 32-hp. gas engine; two 10-in. line scrapers; two 8-in. line scrapers; two 6-in. line scrapers; two 5-in. line scrapers; four 4-in. line scrapers; two 3-in. line scrapers; repair parts for all size line scrapers; and the necessary chain tongs and small tools.

The gathering system was placed in service during July, 1931, but no definite plan of scraper operation was formulated until the beginning of cold weather. It was then decided that a schedule could be prepared only from empirical data obtained in the several districts; scraper operations, therefore, were started on November 1st with this in view, each line in the system being cleaned. To complete this work required three months, after which the procedure was repeated immediately. From the data thus obtained a tentative schedule was determined upon.

These initial runs were fruitful of much valuable information. For one thing, it was noted that accumulation of paraffin was directly proportional to the length of the line and the volume of oil handled. With this as a starting point, all gravity groups, a typical one of which is shown in Fig. 3, were drawn diagramatically to show the distribution of oil gathered by the lines. (Inasmuch as the greater part of the system is composed of 4-in. lines, this size has been used entirely in making all analyses). The results of the first runs were then reduced to the unit "Annual accumulation per 1000 bbl. of oil moved through 1000 ft. of pipe." From these computations the chart, Fig. 4, was prepared, showing the frequency of runs through gravity lines in order to use the static pressure of the tanks and line to propel the scraper. The first of these charts prepared contemplated the handling of a maximum of 100 lb. of paraffin from each line in this manner. Subsequent operations, however, revealed that this figure was low and Fig. 4 has been made on the basis of 150 lb. per run per line. Incidentally it should be mentioned that the Sun's entire plan of operation is based upon the use of static head for drive in the gravity lines. There always have been a few lines in the system that did not have sufficient head to move the scraper, and on these a portable pump is used. During the past year the number of gravity lines in this class has been increased by approximately 200 percent, due to the heavier accumulations and the greater pressure required to move the scrapers.

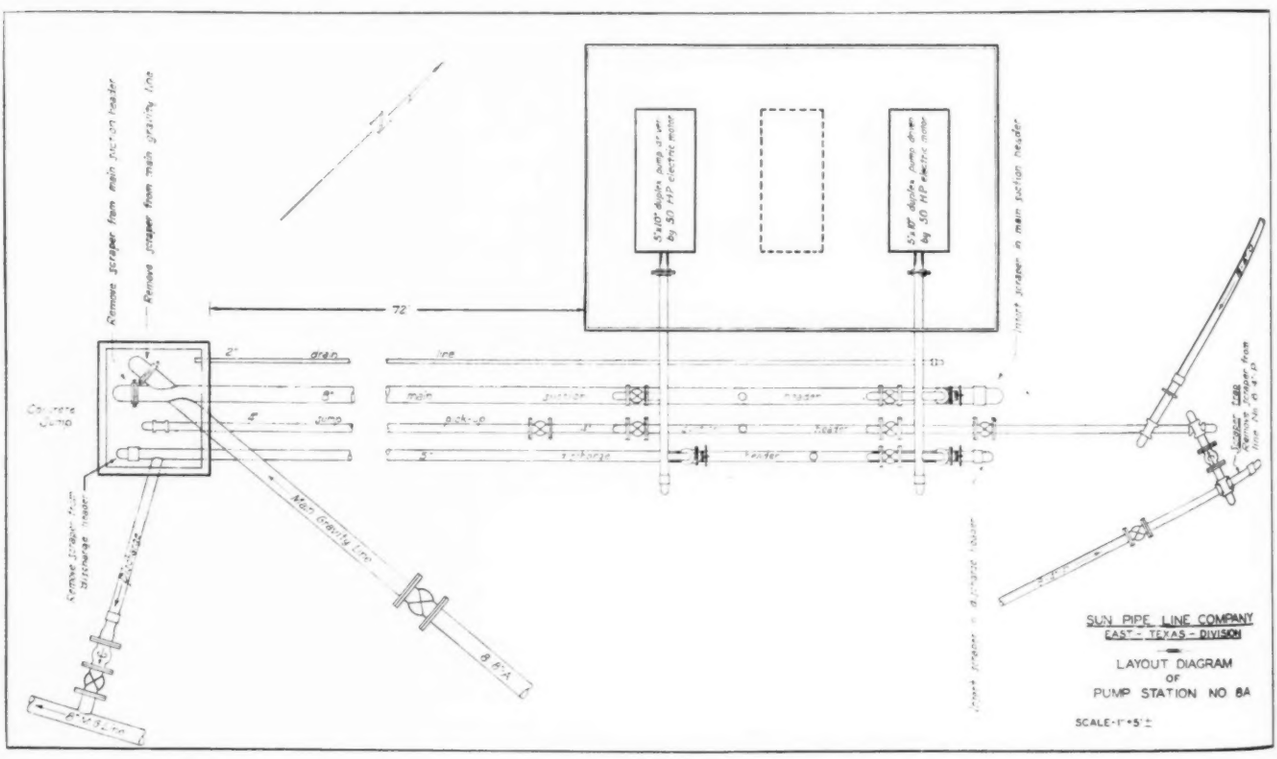
In preparing winter schedules each line is applied to Fig. 4 and its frequency noted. All lines do not follow the predicted results, however, varying according to local conditions, and they are added to or dropped from the succeeding schedule, as the case may be. This occurs mostly in lines having little slope, which causes the paraffin to settle out in greater volume than indicated. When this condition prevails a portable pump is used to clear the lines, involving a cost four or five times greater than a run using static pressure.

The following tabulation summarizes the gathering lines in the Sun's East Texas system, and its perusal will give a better understanding of the scope of the work:

1 line of	10-in. pipe - - - -	26.06 miles
2 lines of	8-in. pipe - - - -	6.44 miles
15 lines of	6-in. pipe - - - -	14.21 miles
6 lines of	5-in. pipe - - - -	8.87 miles
257 lines of	4-in. pipe - - - -	73.73 miles
27 lines of	3-in. pipe - - - -	13.66 miles
308 lines		142.97 miles

When the last general checkup was made approximately a year ago the rate of paraffin accumulation required that the following portion of the above lines be cleaned quarterly: One-half of the 3-in., two-thirds of the 4-in., and all the 5-in., 6-in., 8-in., and 10-in. lines. The remainder of the 3-in. and 4-in. lines had to be cleaned annually, being on the summer

Fig. 2



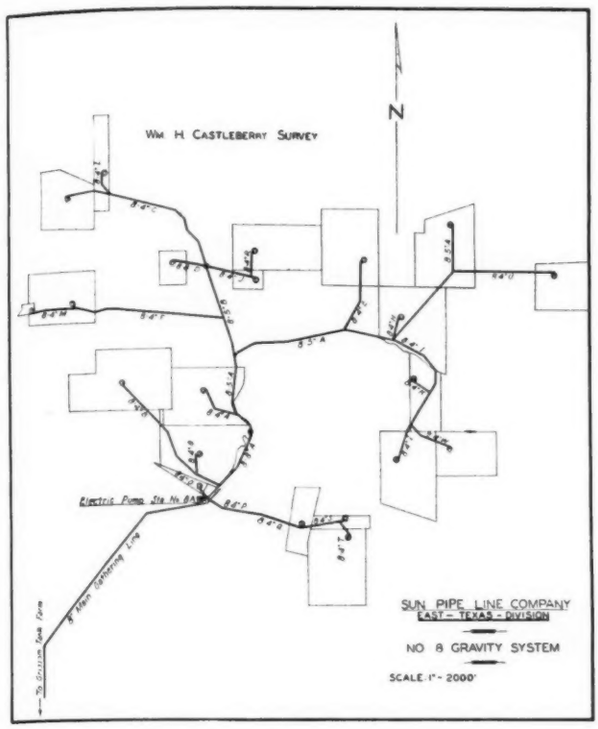


Fig. 3

schedule. During the past year, however, this program has had to be revised somewhat because of increased accumulations, and, as aforementioned, it is now necessary to run scrapers through certain of the lines on a schedule of eight times annually.

While there has been a gradual but consistent increase in the amount of paraffin settling in the lines since the system was first constructed, the fall of 1933 and again the past winter saw a sharp upward turn in this respect. The probable cause of this condition is that the character of the oil produced is changing, and this supposition seems confirmed by centrifuge tests and the more rapid increase in lease stock tank bottom accumulations. Table 1 is a tabulation of the 4-in. gravity lines requiring quarterly runs, evenly distributed over the entire system, that clearly sets forth this fact. Figures only to November, 1934, are presented, later data not having been compiled.

The total volume of paraffin removed from the lines in the course of one complete cleanup of the system is approximately 25 bbl., which together with 75 bbl. of oil lost during the operation, gives a total of 100 bbl. of oil lost quarterly due to scraper operations. This loss represents a very minor part of the expense connected with the work and is given merely as general information.

TABLE 1

Schedule Completed	Number of Lines	Gross Length	Paraffin Removed per 1000 ft. Pipe per Year
May, 1932	28	88,200 ft.	7.0 lb.
December, 1932	51	158,100 ft.	5.1 lb.
January, 1933	23	78,200 ft.	19.0 lb.
April, 1933	32	96,000 ft.	24.6 lb.
September, 1933	54	145,200 ft.	18.1 lb.
December, 1933	112	229,800 ft.	30.3 lb.
March, 1934	127	249,100 ft.	39.7 lb.
July, 1934	92	261,900 ft.	55.8 lb.
November, 1934	105	286,600 ft.	30.7 lb.

The figures in Table 1 do not represent the total accumulation, but only the actual quantity of paraffin removed from the lines at the scraper pockets. The total accumulation over a given period is unknown, but probably is two or three times the amount shown as being removed from the line. This additional paraffin is cut loose from the pipe and passes, suspended in the oil, into the main gathering lines, eventually reaching the tank farm.

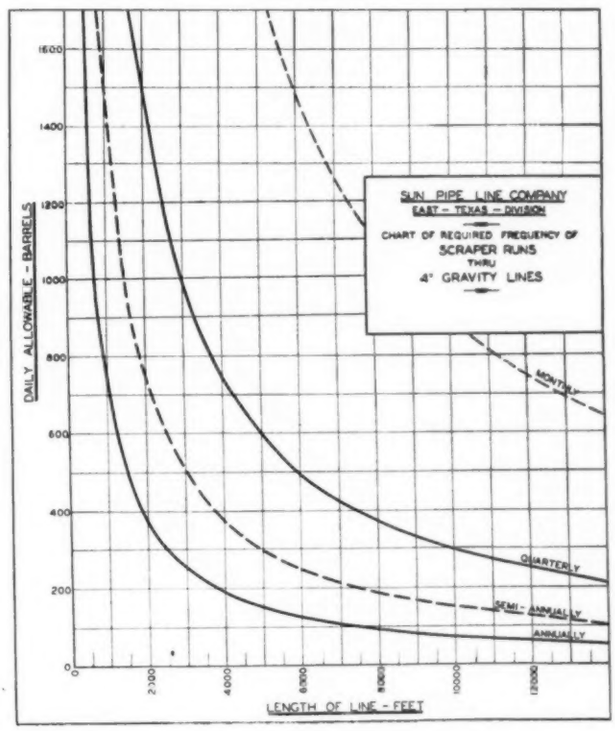
The monthly gross expense incurred in connection with this paraffin removal work has been determined by Sun Pipe Line Company officials as follows:

Labor	$375.00
Transportation	75.00
Supplies and maintenance	25.00
Records and statistical	25.00
Total	$500.00

The average volume of oil handled monthly through the main line being approximately 1,250,000 bbl., this gives .05 cents per bbl. as the unit cost of paraffin elimination, or about 1/100 of the gross gathering expense.

Maximum efficiency of operation of field pump stations by having clear lines at all times; reduced expense in elimination of paraffin by handling in relatively small quantities, thereby utilizing static pressure as power; and an indefinite saving in electric power demand and power consumption through having the full cross-sectional area of both suction and discharge lines, are given by officials of the Sun Pipe Line Company as results that more than offset the expense involved in its program of paraffin control.

Fig. 4



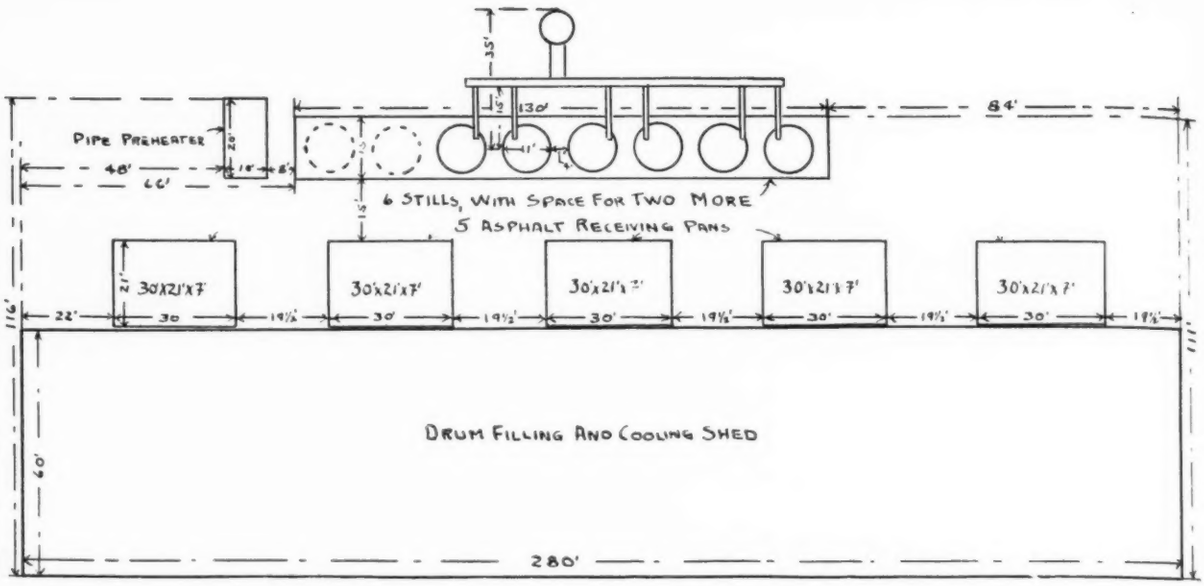


Fig. 14. Proposed layout, oxidized asphalt plant. Scale: 1 in. equals 30 feet.

The Manufacture, Packaging, and Shipping of Oxidized Asphalts

By
CHAS. J. HOLLAND

Article 10

IT will be recalled by those who have followed the series that in Articles 6 and 7 a set of 15 fundamental principles of design and operation was laid down and discussed. Beginning with Article 8 the series has been carried forward with reference to the application of these principles to the job in hand, i. e., the design and operation of Plant No. 4, in Mexico.

Article 8 went into the various details of charging stocks, pumps, lines, fittings, valves, air, and still equipment, etc. Article 9, a continuation of Article 8, had to do with the very important subject of mechanical agitation of the liquid being oxidized, together with a discussion of four commercial means for its accomplishment. We come now in this article (the concluding one having to do with Plant No. 4) to the:

Packaging and Shipping of Finished Products

Plant No. 4 is in a refinery situated on river frontage where ocean-going tank and package-cargo ships are loaded out almost daily. Some domestic rail shipments are made but not a great deal. As with asphalt, nothing but export business was contemplated at the time this writer was called in as consultant. The job was to design and draw up operating instructions for a continuous unit having a capacity of 100 tons of oxidized asphalts per calendar day, with an operating time efficiency of 80 percent.

For the distillation work there were two pipestill units each with a capacity of 5000 bbl. a day and through one of which they processed Panuco crude for the production of steam-refined asphalts and for charging stock for the oxidized asphalt plant. (See Article 8, Table No. 9 for their characteristics.)

An iron drum factory had been completed and in operation, using Niagara Company machinery throughout, including machine for the new Niagara compound side-seam. The capacity was 4,000 drums per day and only one type was being manufactured, entirely of 24-gauge metal. Its style and dimensions were given in Article 4, Fig. 8.

In connection with the side seam of iron drums—a vitally important feature, particularly for low melting point products—while inspecting another asphalt plant in Mexico, the writer observed that they were electrically welding the side-seam. This was not, however, a satisfactory method and the management informed him they had concluded to substitute the Niagara compound side-seaming machine at an early date. They had satisfied themselves that it would produce an absolutely tight seam at considerably less cost than could be done by electric welding.

For packaging and shipping of steam-refined asphalts Plant No. 4 made use of seven 1000-bbl. capacity drum-filling tanks. They were vertically set on brick foundations, equipped with live steam coils and with the shell-type steam-jacketed drum-filling spouts. There was also a drum-cooling and storage shed in the roof of which space had been provided for the storage of empties.

Filling of drums was done on gravity-flow roller conveyors that ran underneath the drum-filling spouts. Immediately after filling drums were capped and sealed and then set out for cooling. This was accomplished by ordinary two-wheeled warehouse type hand trucks, one man and one drum to each truck. When cooled they were stacked by hand labor in rows two or three high for storage while awaiting movement out via steamships.

Plant No. 4 Layout

With the long time experience in mind of Plant No. 1 and considering similarity of Plants Nos. 1 and 4 labor costs and weather conditions, the writer recommended for Plant No. 4 exactly the same system that was employed for five years at Plant No. 1. It had also the advantage of development over a period of years through actual commercial trial and error. For Mexico conditions the writer has never known or heard of anything better.

It complies with Principle No. 11, but does not with No. 15. For the present and considering cheap labor in Mexico the writer believes it better to omit attempt at compliance with Principle No. 15. At some later date when earnings warrant it, probably a completely mechanized system as used at Plant No. 2 can be profitably installed and used (see Article 3 and Fig. 3). It will require great land area and will be otherwise much more costly than Plant No. 1 system but will be much cheaper in operating costs.

Accordingly, the thing to do in Mexico is to use the same types of asphalt receiving or drum-filling vessels (hereinafter called pans); the same filling and cooling sheds, and wagonettes, but number and capacity decreased in the proportion as 150 is to 120, as compared with Plant No. 1. If desired, the pans may be one ft. or so deeper since Plant No. 4 stills are four ft. higher, thus allowing for good gravity flow from last still to tops of receiving pans.

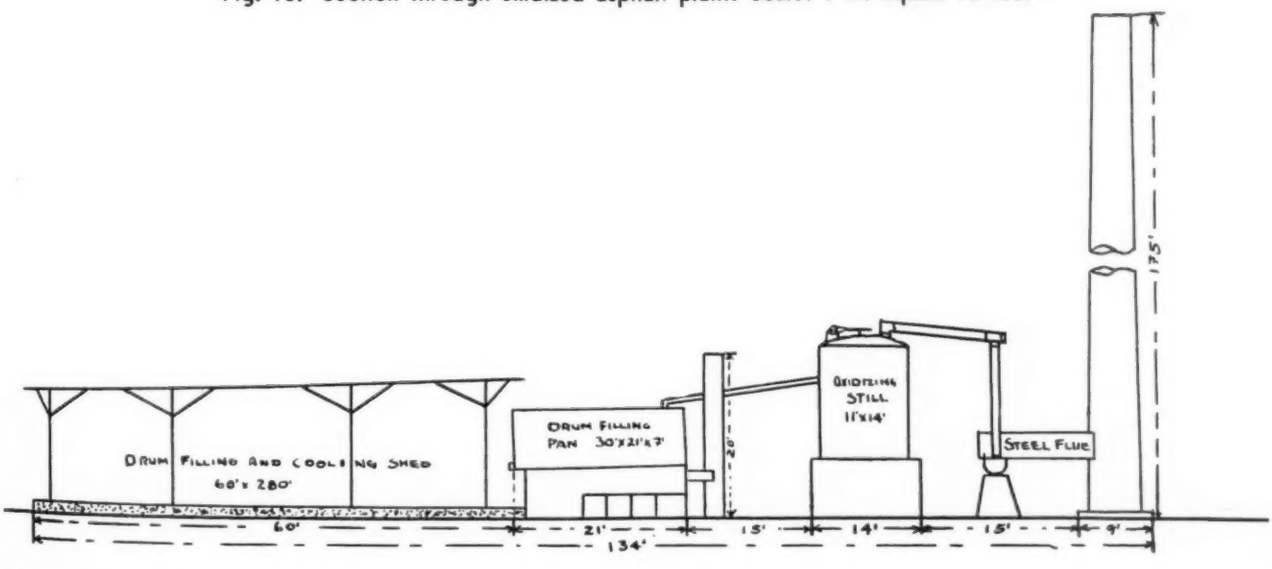
It is recommended pans be equipped with same type of steam-jacketed quick-opening drum-filling valves as used by Plant No. 1. The writer prefers them over the shell type because he believes the valve will fill a drum quicker with less leakage and give a neater looking package. The same as with the shell type, it can be made on the job by welder-mechanic. All pans should be arranged for oil-firing or gas-firing underneath as was done with Plant No. 1.

Fig. 12 illustrates the proposed layout; Fig. 13, a typical section through the plant. Although not shown in the sketch, provision was made for the storage of empty drums in a second story, above the cooling shed roof. From Fig. 12 it will be observed the overall dimensions of the layout are such that there is ample room for everything including two additional oxidizing stills that may be erected at some later date. Layout of preheater and stills are such that it will not be necessary to remove the refinery oil trap on the right or the new docks pipeline conduit on the left. The pipe-heater should be placed to the left as far as possible for two reasons. First, proximity to crude oil pipestills is desirable because most of the time it should be possible to draw the charging stock directly therefrom, thus avoiding loss of heat in storage and reducing piping and pumping. Secondly, since the continuous flow is from left to right, it is desirable to have last still as near as possible to the middle section of the pans layout so as to give a minimum travel for gravity flow of finished products.

As there is soon to be a new boiler house erected and since the present boiler house stack is quite old, it would appear to be more economical to build one new stack of sufficient height and volume to handle new boilers and waste gas disposal from asphalt plant instead of one each for new boilers and the oxidizing stills. In this connection we have to note the experience of Plant No. 2 to the effect that the gases of oxidation are corrosive to iron and steel. It is, however, the writer's experience these gases are not any more corrosive than are the gases from combustion of high sulphur fuel oils such as will be used at the new boiler house. If the new boiler house stack is lined with fire brick for a distance of 25 to 35 ft. from ground level it is his opinion it will last about as long in the combined service as it would for the boiler house alone. The writer believes corrosion experience at Plant No. 2 to be due in large extent to the water spray in the scrubbing towers. They did not report corrosion troubles with either vapor lines or vapor manifold system to and from towers, vapor lines and the concrete stack.

With provision for extra stills to be set in in the future, the ultimate plant capacity would be: $6:8 = 120:X$, where $X = 160$ tons finished products per day, or 6.66 tons per hour. As this would be in excess of limit laid down in Principle No. 3, if and when the two stills are added one of two things would transpire. Either under Mexico conditions experience would show the small excess over five tons as per Principle No. 3 would not be sufficient to prevent satisfactory operations and still give uniform quality products; or some changes

Fig. 15. Section through oxidized asphalt plant. Scale: 1 in. equals 15 feet



would have to be made. One would be splitting into two continuous batteries of four stills each.

This would not be a violation of Principle No. 6 because with a pipe-heater for each battery (and this would be advisable to do) there would be the equivalent of about 5½ stills to each battery. With splitting into two batteries, the present stills Nos. 2 and 3 would be respectively the first stills of the two batteries, thus giving minimum travel to the respective asphalt receiving pans. With reflux system for each battery and possibly the use of the two turbo-mixers now at Plant No. 4, the combined output would be at least 160 tons per day and probably considerably more, up to 200. Regardless of how much this increase would be, the cost of package filling would increase because of necessity for a considerable increase in width of filling and cooling shed. It can go only in one direction; towards the river, if gravity flow is to be maintained from stills to pans. Increase of width means longer travel and cycle time for men with wagonettes, thus calling for more men and wagonettes per ton of asphalt drummed.

Possibly by the time a considerable increased plant capacity is required funds and experience may be sufficiently available to warrant a mechanization of drum filling and handling operations. In which case an entirely different asphalt receiving layout would probably prove advisable. The Plant No. 2 system of pressure vessels has much merit. There are others, such as: (1) use of narrow gauge railway and (2) drum-filling and handling by small electric or gasoline-engine-driven power trucks, as well as different types of asphalt receiving vessels.

Fig. 12 shows five pans. They are to be 21 ft. x 30 ft. x 7 ft. The writer has used a 7-ft. depth instead of 6-ft. as at Plant No. 1 because of better utility of old tank steel now at Plant No. 4 and available for pan construction. Five are somewhat in excess of requirements of a 120 ton per day production. It is based on Plant No. 1 figures as follows: $6 : 150 = X : 120$, where $X = 4.8$. They are equally spaced along length of cooling shed so as to allow for minimum travel and cycle time of drum-filling wagonettes.

The drum-filling and cooling shed area of $(60 \times 280) = 16{,}800$ sq. ft. is also based on Plant No. 1 experience:

$150 : 120 = 21{,}000 : X$, where $X = 16{,}800$.

As each drum requires a cooling space of 5.3 sq. ft. (see Article 2):

$\frac{16{,}800}{5.3} = 3170$ drums, or $\frac{3170}{5} = 634$ tons total cooling space. This is equivalent to $\frac{634}{120} = 5.3$ days for filling, cooling, topping-off, sealing, weighing, and stenciling.

If "topping off" can be avoided this can be reduced 30 to 35 percent. That is to say, for the same output of 120 tons per day there would be required only $\frac{16{,}800}{3} \times 2 = 11{,}200$ sq. ft., leaving 5600 sq. ft. available as storage space. Since when placed close together for storing a drum occupies 3.7 sq. ft., a storage area of 5,600 sq. ft. would take care of $\frac{5{,}600}{3.7} = 1{,}510$ drums or 300 tons. Stacked two and three high it would be respectively 600 and 900 tons.

There is another means of having the cooling shed serve partly for storage. After drums are cooled, topped-off, sealed, weighed, and stenciled, they may then be moved up tight against each other, towards the two ends of the shed and towards the river front side. Due to the use of wagonettes and for quicker cooling of drums (as explained in Article 2) a filling and cooling space of 5.3 sq. ft. per drum is needed. Hence when moved up tight against each other each drum requires 5.3 minus 3.7 = 1.6 sq. ft. less. For example, if the floor happened to be half covered with drums spaced for cooling and were finished ready for shipping, upon being moved up tight an area of $\frac{3{,}170}{2} \times 1.6 = 2{,}536$ sq. ft. would be recovered for cooling use. That is, $\frac{2536}{5.3} = 478$ drums, or approximately 90 tons of asphalt.

So that could we successfully get away from topping-off and also by utilizing the second means of recovering floor space, we could by a three-high stacking, have a storage space for about 1,000 tons of asphalt in the cooling shed and not interfere with the filling and cooling operations.

There is a means for getting away from the troublesome and expensive topping-off operation but so far the writer has never attempted applying it to the standard export drum with a 7-in. opening. He did do it successfully with the one-headed domestic drum and believe it can be worked out for the export drum also. He has reference to the removable ring idea of Principle No. 14, the use of which was told about in Article Two.

If for export the one-headed drum could be used the problem of avoiding topping-off would not only be automatically solved (from Plant No. 1 experience) but also the drumming cost would be reduced by the cost of metal and labor for the one head not used. The writer discussed this possibility with the experts. They were skeptical. One told of a memorable experience. Some ten or 12 years ago Plant No. 1 tried it. They shipped a cargo to England and it took months to get it out of the ship! One expert is of opinion it would work all right if one of two methods are employed. First, the drums might be stacked not over two-high in between decks. More than two high he believes they would smash down and burst open as they did with the cargo to England. Second, they might be successfully stacked as high as required in the ship's hold if drum used were made entirely of 24-gauge metal with the Niagara compound side seam.

Trinidad Petroleum Production Records Broken in 1934

According to an official report made public recently, all previous petroleum production records were broken during 1934 in Trinidad, say Vice Consul Wallace E. Moessner, Trinidad, B. W. I.

The 1934 output mounted to 10,894,363 bbl. from the 1933 figure of 9,561,354 barrels. Of the 1934 production, 6,391,544 bbl. were obtained from Crown lands, and the remainder from private areas.

During the latter year, the number of new wells commenced was 124, as compared with only 81 during 1933, and was the largest number started since 1930. The amount of royalty received by the Government from the production on Crown lands was $416,528 for 1934.

Exports of crude likewise increased from 8,909,298 bbl. valued at $10,819,464 in 1933 to 9,981,774 bbl. valued at $14,056,128 in 1934. Of the Colony's total value of exports in 1934, petroleum contributed 63 percent as compared with 52 percent in the previous year.

Up to the end of 1934, a total of 2,106 wells have been drilled in the Colony, of which 1,339 were located on Crown lands. The deepest well on the island is 6400 ft. deep while there are 56 wells exceeding 4000 ft. in depth. During 1934, the United British Oilfields of Trinidad, Ltd., was given an exploration license covering 107,109 acres of Crown lands in the central part of the island.

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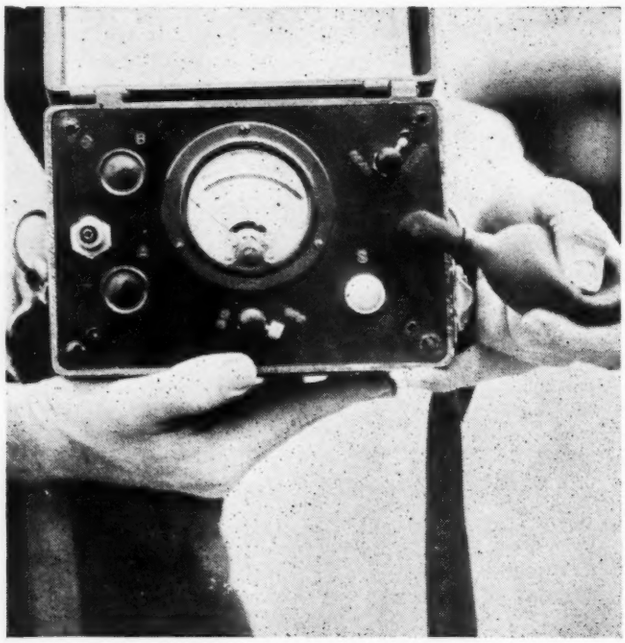

A close-up of the filament type leak detector

City Plant Line Losses

By

ROY W. PARKER
Oklahoma Natural Gas Company

THE subject of gas losses is always an unpopular but universal topic among gas men. Beginning with the laying of wooden pipes until the present time, gas leakage has always been accepted as normal and inevitable. The pioneer plant superintendent assumed that sooner or later each joint would spring a leak; therefore, in laying mains, each joint was surrounded by a conical pile of broken stone, enclosed in a covering of thick tarred paper, through which rose a vertical trumpet-mouthed pipe. The leakage was conveyed through "escape pipes" to lamp posts, where it was utilized for illumination purposes.

Today, fifty years later, billions of cubic feet of gas are lost annually because of leakage in pipe line systems. The sources of gas leakage are more numerous in a distribution plant than in any other part of a gas system, because of the great number of fittings that are installed in the vast network of pipe necessary to serve a community.

The person who is responsible for the proper operation of a city plant is familiar with the definition of gas losses, the significance of leakage reports, and the expense this waste represents.

Almost every plant superintendent who has or shares the responsibility of a pipe line system has a rather definite idea of its condition. It is not unusual, however, to find two responsible members of an organization who differ radically in their opinions regarding the condition of their underground lines. Not infrequently those opinions are based on memories of certain limited observations of conditions that may not have been representative. Correct conclusions on which to base maintenance procedure can come only from a systemized inspection.

When a distribution leakage survey is begun, usually between April and October, the inspector's first duty is to ascertain the location, sizes, type, and lay dates of all pipe involved within the proposed survey limits. In addition to the maps showing the gas lines, maps should be obtained showing the location of telephone, telegraph, and electric lines.

These maps are procured in order to safeguard the properties of others when contacting the gas lines. It is often necessary to make arrangements with the city management to allow the men to go into the streets and do such work as is necessary in the inspection. General knowledge of the plant construction and conditions will determine the method to be used; usually, in hope of finding the largest leaks, a quick

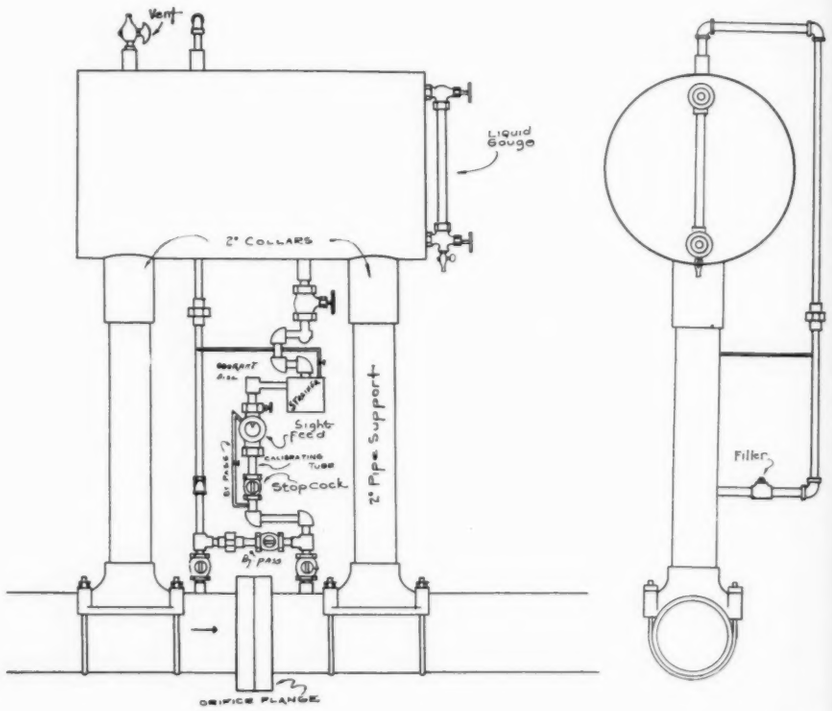

Fig. 1. Diagrammatic sketch of odorizing equipment

Moore Beam Hangers have earned an enviable reputation for uninterrupted performance under the hardest service conditions. Moore Hangers stand up because they are sturdily built; they have effectively lubricated bearings of ample bearing surface; they align properly and distribute the load evenly. Convenience in handling and adaptability to different types of beams are other features of importance. To meet all field requirements adequately, Moore makes a complete line of these trouble-free hangers. Either roller bearings or oil bath bearings are employed; reins are 1½" or 2" in diameter. Write for descriptive bulletin.

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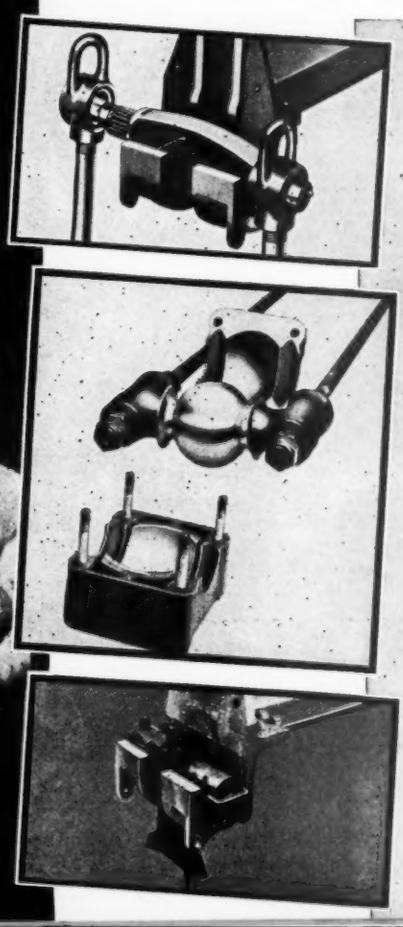
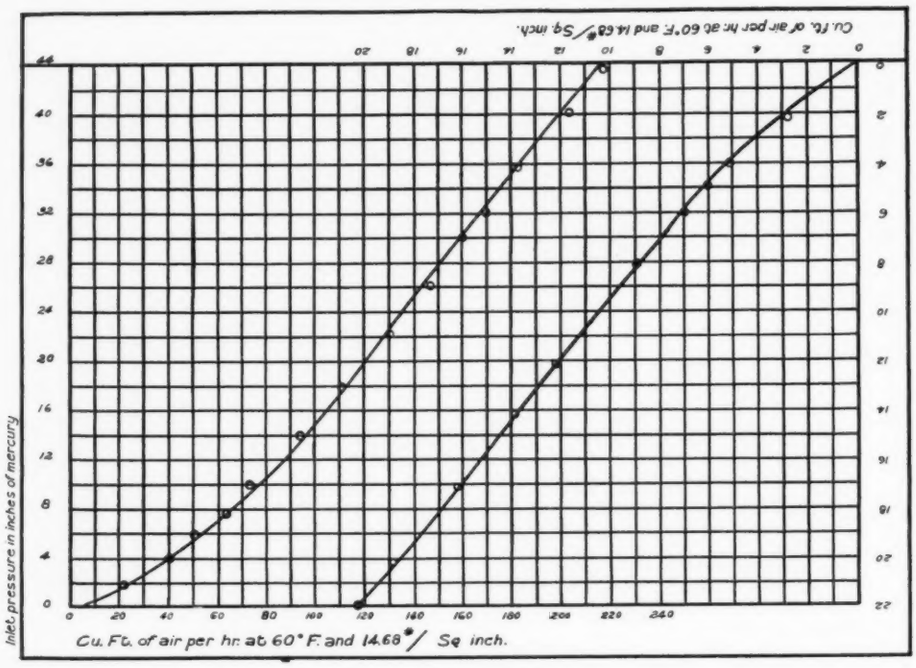




Pressure vs. leakage through 15¾-in. pipe connections, made up hand tight. Ascending pressures

inspection is made. Someone familiar with the system walks the lines carefully, looking for visible indications of gas leakage such as soil drying and discoloration or dead vegetation over the line. Those found in that manner are usually large leaks and can be repaired before a general inspection is begun.

There are several methods of making leakage tests and any one or all may be applied in conducting the various surveys. The most common tests and methods are the bar hole and flame, soapsuds testing, the use of stenches, a leak detector, pressure drop, metering-in and metering-out. All these methods have their application in a general leakage survey, and their use would depend on individual conditions in a city plant.

The objective in any leakage survey is to eliminate the waste and correct any condition that might prove hazardous to the public and expensive to the company. The public liability report itemizes the cost in dollars and cents that is necessary to satisfy claims that arise from personal and property damages caused by gas explosions. In addition to the direct tangible cost of accidents, there is the less tangible but probably more important cost resulting from the loss of public confidence and adverse public relations.

Special safety precautions are of paramount importance in some city distribution systems. In Vienna, Austria, it was required that where the pipe line was laid under street paving or near buildings, each coupling had a "Schnüffelrohn" or smell pipe—a device for making a quick test for leakage. The device consists of a piece of sheet iron, cut and bent to form a hood, set over the coupling. The hood is connected to a pipe of small diameter that extends to the ground surface. Each day the inspectors were required to smell each "Schnüffelrohn."

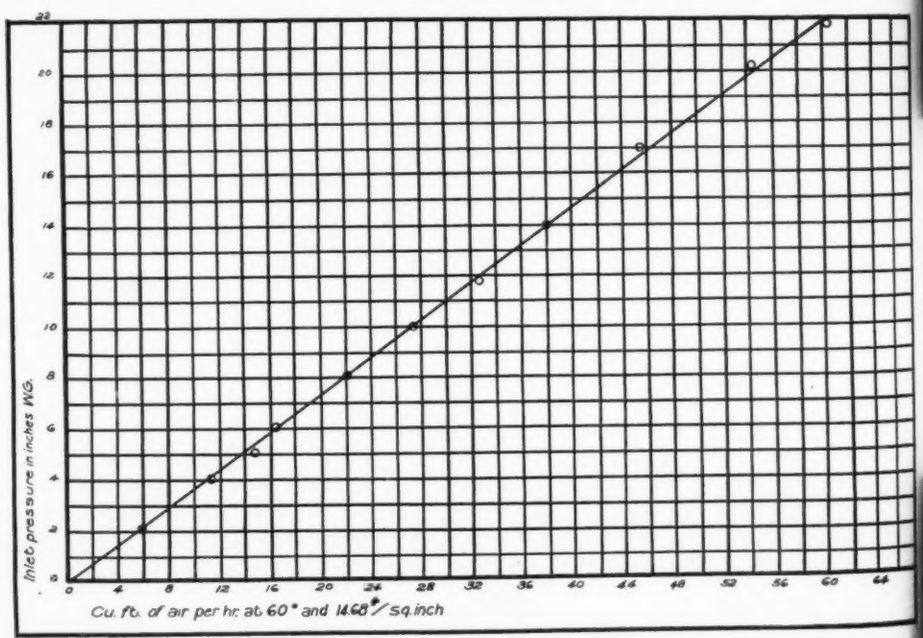
There is a continuous effort on the part of the plant superintendent to minimize leakage, particularly any loss that might result in expensive and harmful reactions. Although the volume lost might be less it is leakage that finds its way to a basement, building walls, conduits, etc., that must be respected.

Odorization of the gas is a method commonly used to detect leakage that might prove hazardous. It is the concensus of opinion that the use of odorized gas will not remove the necessity for proper leakage inspections or prevention work, but it will be of great assistance, particularly in the curtailment of damages caused by gas leakage. A summation of opinions gives the following reasons the gas companies have found to amply justify odorization.

1. The reduction in personal danger due to fire, explosion, or asphyxiation.
2. The reduction in property damage due to fire and explosion.
3. The reduction in gas losses due to leaks.
4. The reduction or elimination of losses to the consumer.

It is the belief by companies who odorize that the first mentioned reason justifies the expense of such an operation, and is considered the best insurance a company can buy.

Periodic odorization in small city plants has proven its value, with simple, manually-controlled equipment being used. Where continuous odorization is employed it is necessary to have an installation that will proportionate the amount



Pressure vs. leakage, flow through 30-in. of moist adobe soil. Ascending pressures 6 1/32 x ¼-in. slots in ½-in. pipe

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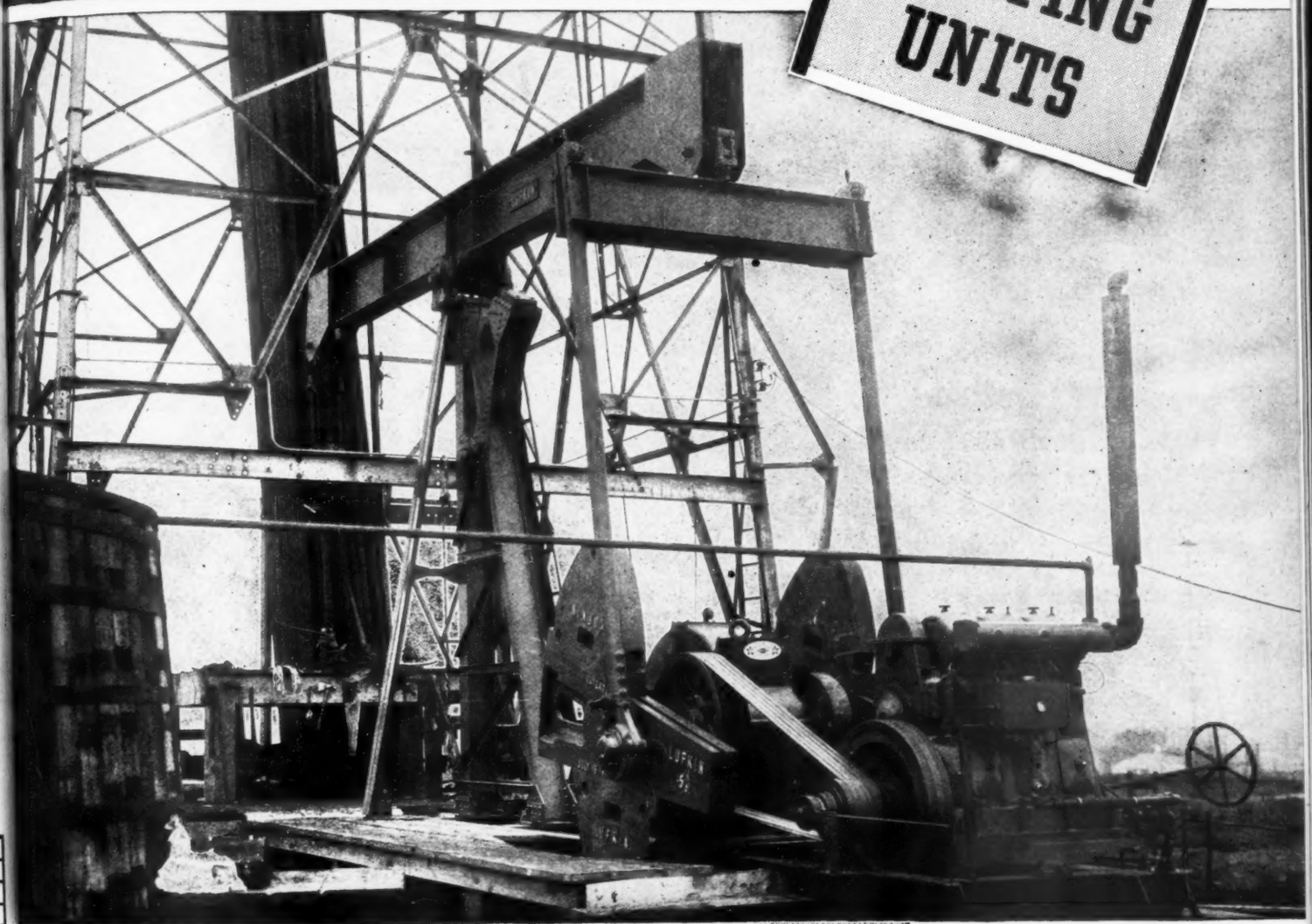

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Inspecting a city plant manhole for combustible gases. This method leads to the discovery of considerable leakage, and is effective where breaking of paving is necessary

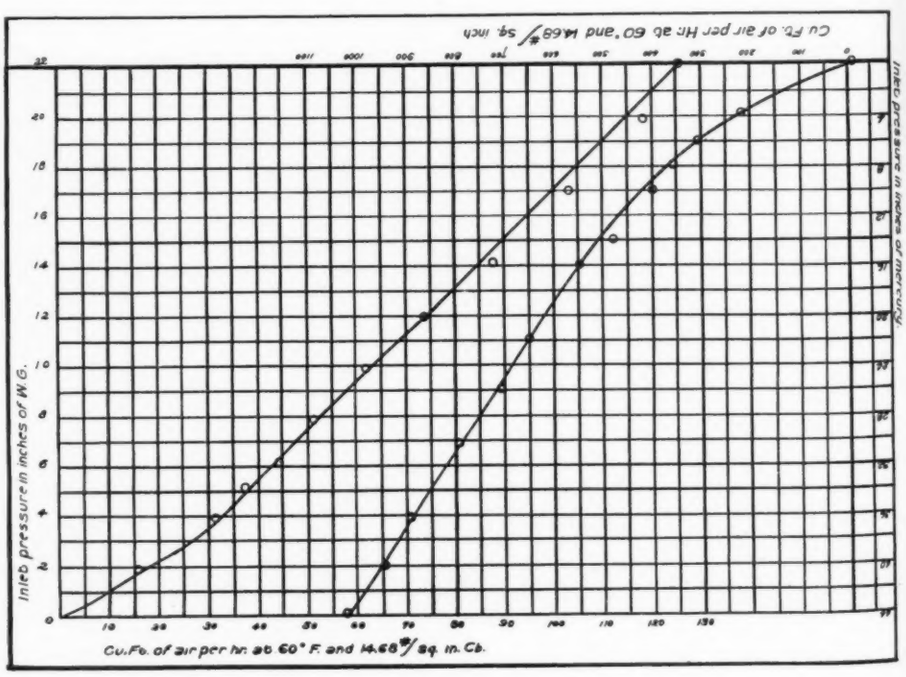
of fluid to the volume of gas passing. The amount of odorant required is somewhat intangible, and practice throughout the country (where Cal-Odorant is used) varies from one to four gallons per M cu. feet. The lower limit is that where explosions might occur, in cases, for example, where the odor would not be noticeable in the presence of normal cooking odors or pre-occupation. The upper limit is that where very small leaks of no safety or economical importance would be detectable. Two gallons per million seems to be the concentration that satisfies the average condition.

Fig. 1 is a diagram of an odorizing unit that has proven suitable for continuous operation. The method operates on a differential pressure created by the orifice disk in the gas line. Above the sight feed is a housing containing an odorant disk. Since the same differential exists across this small disk as exists in the large gas orifice, it is evident that any differential change will take place at both points simultaneously, thereby regulating the odorant flow to the gas flow. In order to eliminate odorant disk changes with each gas line disk change, a by-pass is provided. By opening or closing this line the proper differential on the liquid disk can be maintained. To check the flow of an odorant, close the stop below the calibration tube, open the small by-pass, and note the time it takes to fill the measured calibration tube.

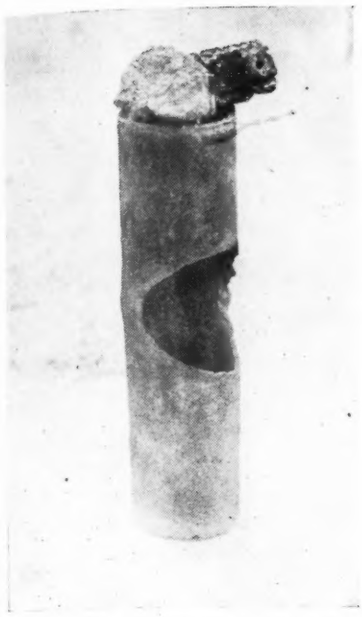
It has been reported that fairly accurate regulation can be maintained by the sight feed valve. The valve is set on the low flow to introduce the correct number of drops per minute. The flow on the high load can be calibrated and adjusted by the differential by-pass.

The practice of odorization, together with a systemized survey with a leak detector, have proven to be an inexpensive and extremely important means of reducing hazardous conditions in a city plant. The filament type leak detector is one commonly used. This instrument uses the combustion principle to indicate the degree of gas concentration. It is very convenient and rapid in making leakage inspections of gas curb boxes, water curb boxes, telephone, telegraph, or electric manholes or vaults. The atmosphere of any inclosed space is aspirated by a bulb over a platinum wire heated by two dry cells in the instrument. If combustible gases are present in this atmosphere they ignite when passing over the filament, changing the resistivity of the wire which is indicated on a scale that registers in percent combustibles. While the percent of gas in a manhole will not always indicate the source of leakage, tests of the degree of gas concentration in adjacent vaults, will give a more definite location. This instrument is sometimes used in a general bar hole test. At locations where flashing is not advisable a rapid check can be made for the absence or presence of gas in the hole.

Records dating back several years will probably show that considerable data have been tabulated giving the locations of leakage in a distribution system. The leaks found have been classified, and the number inspected has been recorded, but in many cases neither the volume of loss nor the hazardous operating condition created has been noted. Such a record has exposed faulty methods of construction, but does not give a true picture of conditions that would influence a concen-



Capacity of 6 3/32-in. holes discharging through sandy loam soil at a depth of 48 in. Descending pressures



The result of extreme electrolysis. Lightning followed a guy wire from an electric pole to strike the gas line. The opening had the appearance of a torch cut. The pieces shown on top of the pipe are fused silica, having the physical appearance of molten glass. A bulge around the pipe can be seen at the center of the opening

trated attack on losses, with the minimum of effort and expense.

The amount of money that can be spent for maintenance each year is usually limited. This necessitates the application of any given amount being applied where the most leakage can be eliminated and the greatest knowledge of the condition of the underground lines acquired. Several factors should be considered when working toward that end. One of the factors contributing most to leakage is soil corrosion, particularly in the older steel main systems. Soil corrosion data and the history of the laying of the line provides the operator with knowledge of suspected areas in which to concentrate the search for losses. Deviations in general sub-soil pipe behavior are sometimes brought about by extremes in electrolytic phenomena, faulty material, or fabrication of pipe, but generally the type of soil will indicate the life of the line or when and where losses should be expected.

Soil surveys in distribution systems is a general practice with many companies. A chemical analysis is made and the electrical conductivity or resistivity is indexed. Several methods for each determination have been published in the literature. The Shepard Canes or earth resistivity meter seem to be the apparatus that is best suited for speed, accuracy, and dependability. One company of the Pacific Coast Gas Association offered the accompanying table in relation to soil resistivity and corrosiveness.

A paper by Mr. E. A. Munyan, delivered at the recent American Gas Association convention presents data showing the advisability of using copper pipe and brass fittings in service connections. Their laboratory tests show the life of copper tubing to be about twelve times that of steel, or 11½ years for steel and 135 years for copper. The economics of this practice in their properties is presented in this paper.

Several methods to make a chemical analysis of the pipe

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Class of Soil	Descriptive Term	Rod Readings, Ohms Cms.	Estimated Life of Bare Steel Pipe, Yrs.	Specifications	
				Mains	Services
1	Excellent	10,000 - 6,000	25 or more	Steel—no coating	Wrapped-steel
2	Good	6,000 - 4,500	17 - 25	Steel with protecting coatings. Coating to cost not more than 10 percent of entire cost of job.	Wrapped-steel
3	Fair	4,500 - 2,000	10 - 17	Cast iron, copper or heavily protected steel. 20 percent entire cost.	Copper tubing
4	Bad	0 - 2,000	0 - 10	Cast iron or copper. No steel.	Same as Class 3

ditch soil are known and used. The time required to make many of the tests defeats their purpose. Scott Ewing, A.G.A. Research Associate, offered a procedure at the recent convention of that body. The test he outlined is a modification of the titration method described by Denison,[1] and determines the acidity of the soil, and when correlated with the resistivity measurement, an index is established for that particular location.

Unquestionably there will always be a few leaks in a city plant. If we accept them as unfortunate evils it is well to have an understanding of the effect of pressure on leakage, so that we may calculate or more accurately estimate the savings effected by operating at reduced pressures.

Many tests have been conducted by individuals and groups in an effort to obtain data on distribution pressure control. Larson,[2] Portland Gas Company, showed leakage to be directly proportional to gauge pressure. Line pressures between 1.7 inches and 13 inches were used. Rawlins and Wosk[3] found this ratio in transmission lines.

Mix,[4] of Chicago, found leakage is sometimes proportional to the square root of the gauge pressure and at times approaches the gauge pressure.

Renz,[5] by the pressure drop method on underground leakage in small pipes (service pipes), showed leakage to be directly proportional to gauge from 12 inches to 40 pounds.

Some work has been done on flow of gases through broken solids.[6, 7]

The charts shown are the graphic results obtained by the Pacific Coast Gas Association in some of their leakage work as reported in *Western Gas*, 1933.

Deviations in general leakage inspection practices are often necessary because of local conditions. Personal viewpoints may differ or maintenance policies may vary with different companies, yet it is undeniable the common purpose is to eliminate leakage that will increase profits and conserve a valuable commodity.

[1]Bureau of Standards Journal, Research, Vol. 10, pp. 413-426, March, 1933.
[2]Proceedings, Pacific Coast Gas Association, 1928.
[3]"Leakage from High-Pressure Natural-Gas Transmission Lines," by E. L. Rawlins and L. D. Wosk—U.S.B.M. Bulletin 265, 1928.
[4]Proceedings, American Gas Association, 1929.
[5]Proceedings, Pacific Coast Gas Association, 1930.
[6]"Flow of Gas Through Beds of Broken Solids," by C. C. Furnas—U.S.B.M. Bulletin 307.
[7]"The Resistance of Packing to Fluid Flow," by F. C. Blake, American Institute Chemical Engineering, 1922.

Hose Connection Solves Sump Line Problem

IN sump pit operations the coupling connection between the pipe from the pit and that leading to the pump has often proved a source of trouble. Not only is the metal connection placed under strain due to the extreme angle, but vibration set up by the reciprocating pumps causes the metal to crystallize and develop leaks. As a result, air gets into the line, is drawn into the pump and passed into the rotary drilling hose, causing a dangerous "water hammer."

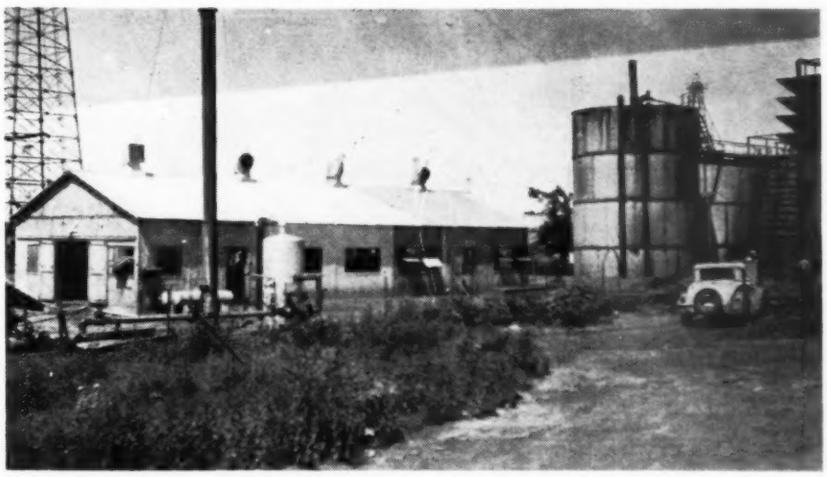
Drillers in the Seminole and Oklahoma City fields solved the problem by substituting a 5-ft. section of rubber suction hose at this point, as shown in the accompanying illustration, which is attached to the pipe with metal clamps. Because of its flexibility, vibration does not affect it and a permanent, air-tight connection is maintained.

This hose, manufactured by The B. F. Goodrich Company, Akron, Ohio, is the same type widely used for flexible connections on suction dredges. The inside tube is made of "Armorite", an elastic rubber compound developed for resisting abrasion.

Handling Small Production by Gas Lift...Oklahoma City Field

BY
S. F. SHAW
Consulting Engineer,
San Antonio, Texas

Part II



Mid-Texas Petroleum Co. compressor plant in Oklahoma City field containing four 90-hp. direct-connected compressors—used on intermittent flow.

Intermitting Through Tubing with Plunger

INTERMITTING through the tubing with plunger has been successful in the Oklahoma City field, after wells have declined to the capacity at which this method of intermitting becomes acceptable. The points of production at which intermitting through tubing has seemed to become practicable in this field is approximately that indicated in Table 5.

TABLE 5

Practicable Capacity of Tubing for Intermitting in the Oklahoma City Field

Dia. of Tubing	*Bbl. of Oil per Day*
2½-in.	100
3-in.	150
4-in.	200-300

Instances have been noted in which considerably greater production has been obtained than that mentioned in Table 5, when intermitting through the tubing, especially where bottom-hole pressures are high, but experience seems to indicate that intermitting through the casing results in larger production than through the tubing if the well is capable of producing a quantity greater than that mentioned in Table 5.

When intermitting through tubing, the capacity depends very largely upon the flowing pressure at the bottom of the tubing. The capacity of different sizes of tubing at different flowing pressures is approximately that indicated in Table 6.

The capacity of tubing for a given flowing pressure will vary, depending on the length of the pipe, on the quantity of water mixed with the oil, on the temperature of the gas, and on the gravity of the oil. Since these conditions vary from well to well, there is no fixed figure for capacity that can be stated, although those noted in Table 6 will serve as fair approximations for the Oklahoma City field. For any other field there would probably be considerable variations from those shown in Table 6.

TABLE 6

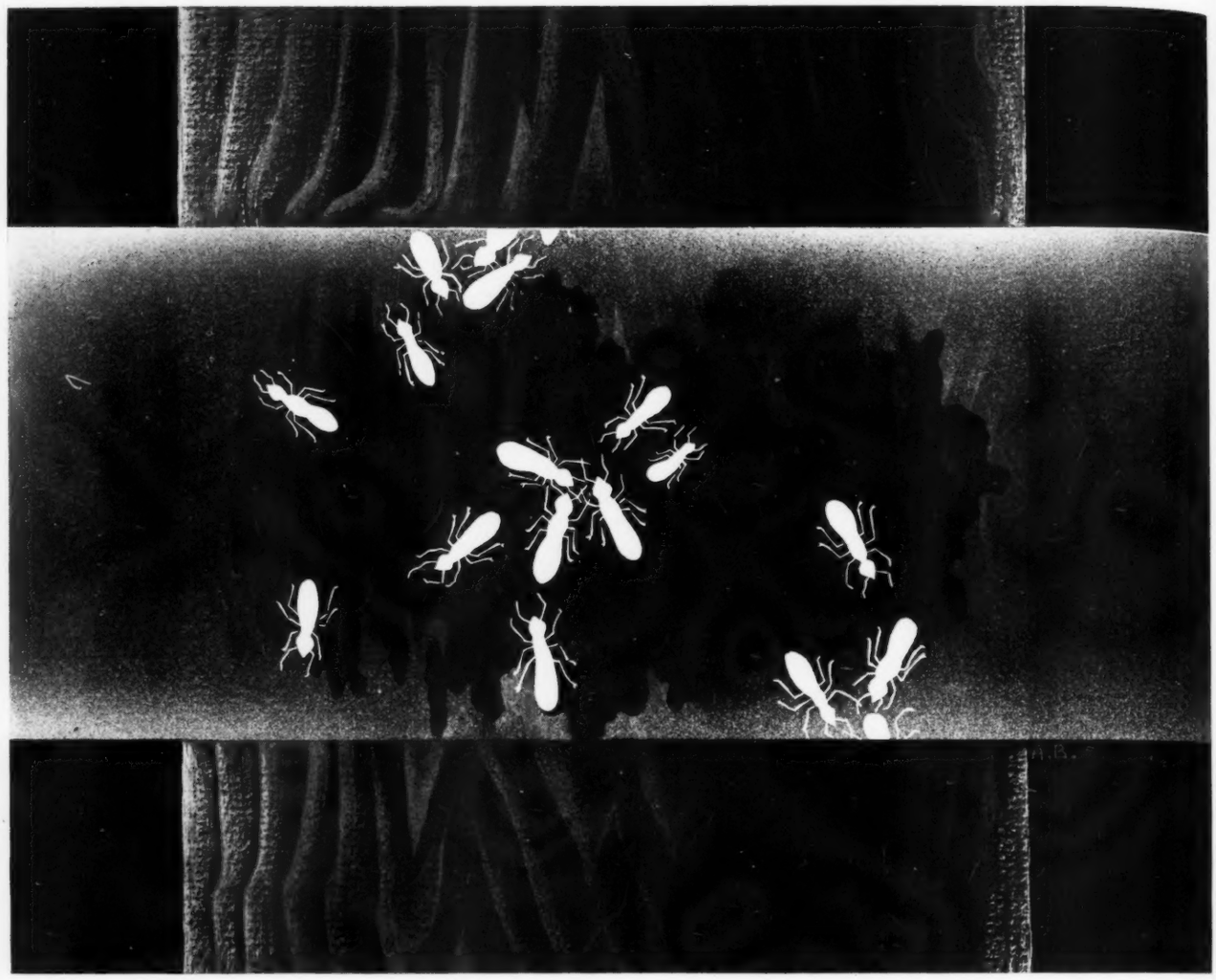
Capacity of Tubing When Intermitting in the Oklahoma City Field, for Different Sizes of Tubing and Different Flowing Pressures

Lb. per Sq. In. Flowing Pressure	*Bbl. Capacity per Day* 2½-in.	3-in.	4-in.
50	25	35	70
100	60	90	180
150	100	150	300

Owing to the fact that most of the wells in the Oklahoma City field were tubed with 2½-in. tubing when using continuous gas-lift and when intermitting through the casing, there is an advantage in making use of this 2½-in. tubing string for plunger lift if at all possible to do so. It is necessary only to ream the tubing that has been in use, thereby avoiding a considerable outlay for a new string of tubing. In some cases, production on natural flow, followed by continuous gas-lift flow, and later by intermitting through the casing, has been carried down to the point of production where a 2-in. tubing is capable of handling all the oil that the well can make.

Westgate Oil Co. No. 1 Blevins is producing about five bbl. of oil per day with about 30 bbl. of water on intermittent flow through 2½-in. tubing; also the same company's No. 1 Wilson is producing about 25 bbl. of oil and 17 bbl. of water per day through 2½-in. tubing, having been placed on intermittent flow through tubing when making about 90 bbl. of oil per day.

The wells of the Westgate Oil Co. in this area are sup-



Invisible destroyers

TERMITES work stealthily — in the dark. That they may be unobserved and unmolested, their attacks on, say, a wooden support are confined to its interior. Left standing is a thin outer shell. . . . And, often, not until things collapse is the slow, insidious destruction brought to light.

Among the "termites" that lurk in the very foundations of many industrial organizations are such invisible forces of reaction as "standard practices," "established methods," "acceptable formulæ" and "satisfactory materials." Unmindful of their portent, a business may move along complacently — until, suddenly, it finds that an alert competition has captured the market because it discovered means of decidedly improving the quality of its product and reducing the manufacturing cost as well.

Steel tools, implements, appliances, vehicles, engines, machines — or parts thereof, such as gears, shafts, bearings, springs, wheels, housings, frames, bodies . . . does your organization make anything the salability of which you would like to help advance still further? There is scarcely an instance in which the addition of a relatively small percentage of Molybdenum will not improve <u>any</u> steel — whether plain or specifically characterized by one or more of the various other excellent steel-alloying elements in existence. Furthermore, the production economies "Moly" effects will usually alone more than absorb its cost.

To engineers, metallurgists and production executives we offer these interesting books: "Molybdenum in 1934" and "Molybdenum in Cast Iron — 1934 Supplement." Also ask us to mail you our periodical news-sheet, "The Moly Matrix." Be free, too, to enlist our Detroit experimental laboratory's help at any time. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

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INDUSTRY'S MOST MODERN AND VERSATILE ALLOY

plied with compressed gas from a plant consisting of three 90-hp. direct-driven gas-engine compressors, which plant handles four small wells, producing respectively 90, 90, 25, and 5 bbl. of oil per day. The 5-bbl. well adds practically nothing to the fixed cost of the operation, since there is almost no down time, and no expense for well jobs. Probably two percent of down time at the well will cover the actual loss of operating time, and the time of only one man is required to make changes in the plunger on any well when trouble develops.

In several instances, when tubing for intermittent flow was installed, it was found when intermitting that the gas from the formation was sufficient to flow the well without the necessity for supplying additional gas from the compressor plant. Such an operation is, of course, quite inexpensive. Among wells operating in this manner are the Carter Oil Company's No. 1 C. G. Frost, which is making about 30 bbl. of oil per day, intermitting for a long time on natural flow through 2½-in. tubing. The Westgate Oil Company's No. 1 Grace has been intermitting part of the time on natural flow through 3-in. tubing, making about 90 bbl. of oil per day with 10 to 15 percent water.

In some wells, particularly those having 9-in. casing, the tubing first employed with continuous gas-lift was 3-in.; therefore, it has often seemed practicable to have this string of tubing reamed and employed for intermittent flow through the tubing. As noted in Table 6, the capacity of 3-in. tubing is approximately 50 percent greater than that of 2½-in. tubing.

In a few instances, 4-in. tubing has been employed for continuous gas-lift flow. When using 4-in. tubing in 7-in. casing, the flow would be through the tubing, but when 4-in. tubing is used in 9-in. casing the oil is flowed through the casing, the gas being introduced through the 4-in. tubing. The reaming of the 4-in. tubing has permitted this tubing to be employed for intermittent flow with a plunger. The capacity of 4-in. tubing as noted in Table 6, is approximately twice that of a 3-in. tubing for a given bottom-hole pressure. There is little need for a larger tubing than 4-in. for intermitting in the Oklahoma City field, particularly at this stage when the wells have declined to the point where the remaining life of the well will not be great.

If the diameter of the tubing that has been employed for continuous gas-lift is not suitable for use in intermitting through the tubing, it is found to be less expensive to order the tubing of the proper size direct from the mills, drawn to the exact diameter required, rather than to have the tubing reamed in the field. Tubing for this class of operation can now be obtained from the mills.

The quantity of gas required for intermitting through the tubing in the Oklahoma City field depends on the quantity of gas associated with the oil in the formation, on the bottom-hole flowing pressure, and on the size of the tubing. In general, taking all conditions into consideration, the average quantity of input gas used in the Oklahoma City field ranges between 2000 and 2500 cu. ft. per barrel. When there is considerable water with the oil, the input factor per bbl. of oil is about twice that stated above.

Output gas factors are practically impossible to estimate, owing to the intermitting character of the discharge. Attempts have been made to make these calculations on charts that make one revolution per hour and result in a fair degree of accuracy, but the 24-hour charts in general use do not permit reliable estimates to be made.

In the early days of the use of intermitting through tubing with plunger in the Oklahoma City field, considerable trouble was experienced with freezing of the gas lines on the surface, and with depositing of paraffin in the tubing, thereby causing the plunger to stick. The main-line pressures have been about 500 lb. whereas the pressures on the casings of wells intermitting through the tubing are usually under 150 lb., therefore, the gas is cooled considerably in expanding from a pressure of 500 lb. to 150 lb.; however, the difficulty of freezing the reducing valves on the surface has been fairly well eliminated by installing electric heating elements in connection with the reducing valves.

It has been noted that but little trouble has been experienced with paraffin accumulations when intermitting through the tubing if the compressor plant is situated close to the well. In such cases, the line pressure is carried at a low point, that is, 150 to 200 lb. per sq. in., and the gas, as a rule, reaches the well at a temperature upwards of 100 deg. fahrenheit. It is believed that these conditions explain the lack of paraffin in such wells.

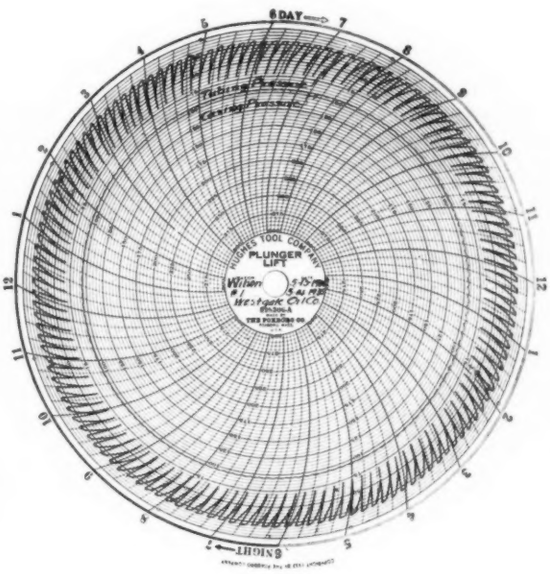
General Observations on Lifting Small Wells by Gas Lift

The use of chemicals for preventing deposits of paraffin in the tubing and casing has been employed to a considerable extent, but opinions seem to differ as to the efficacy of this method in the Oklahoma City field. Apparently large quantities of casinghead gasoline or of distillate are more satisfactory than small quantities of especially prepared chemicals.

Adaptation of the method that will permit production to be lifted at the maximum rate, and at a cost that is not excessive, is contributing toward making it possible to lift oil economically in the Oklahoma City field to a low point of production. This, in turn, delays the time when the well must be abandoned and, therefore, increases the ultimate recovery.

By some operators it has been supposed that the lifting of oil under restricted methods would operate to the disadvantage of gas-lift methods. It has been found, on the contrary, that the lifting of oil in small quantities by gas-lift, especially at a time when pressures are high, contributes to favorable conditions for this method, and also prolongs the length of time when such methods meet with favorable conditions; therefore, there is a long life for a compressor plant under such conditions.

Under restricted conditions of production, the outlay of capital on gas-lift and also the operating costs are greatly reduced. The chief disadvantage lies in the lack of knowledge amongst operators of handling this method, but this handicap is gradually being overcome.



Casing and tubing pressures of a well intermitting through 2½-in. tubing in the Oklahoma City field

. . . the Small Steel Valve with the Big Guarantee

Here is a small valve that ends small-valve troubles —a valve you can put into *any* field or refinery line under 2″—and put in to *stay.*

- Handles all pressures to 800 lbs.—at temperatures to 750° F.
- Corrosion-resistant.
- Machined from solid steel bar stock.
- Replaceable stainless steel working parts.
- Free replacement parts if the valve fails from *any cause* within five years.
- Low cost—long life.
- Eight sizes ranging from ¼″ to 2″.

Get the facts *now* on this money-saving, trouble-saving new valve.

Mail coupon for complete description and prices.

CHAPMAN

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS

Send me—without obligation—your bulletin describing the new Chapman List 960.

Name _____

Firm _____

Street _____

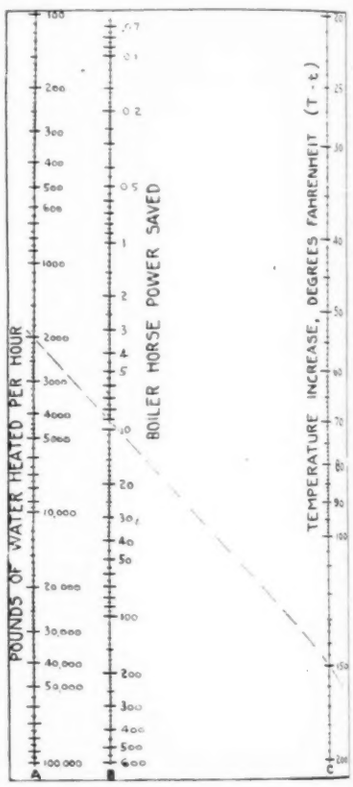
City _____ *State* _____

How Much Power Will a Feed-Water Heater Save in Our Refinery?

By W. F. SCHAPHORST

IN too many refineries the feed-water heater is a device whose value is not fully appreciated. The idea persists that feed-water heaters are "made to sell" mostly, that they are a "theoretical" addition to the plant rather than a practical addition. This statement is commonly found in advertisements, "A feed-water heater will save from 10 to 25 percent of your fuel," and the reader or prospective buyer habitually adds his grain of salt. He has become calloused to statements of this type, which frequently are exaggerations when applied to other equipment.

But they are *not* exaggerations when they refer to high grade feed-water heaters. So, in order to set any doubting Thomases aright I have developed this chart. Simply lay a straightedge across the chart: column B immediately gives the boiler hp. saved by almost any high grade feed-water heater.



For example, if you want to use 2000 lb. of water per hour and if a feed-water heater will increase the temperature of the feed 150 deg. fahr. how many boiler hp. will the heater save?

Connect the 2000 (column A) with the 150 (column C) and column B shows the saving to be nine boiler hp., as indicated by the dotted lines drawn across the chart.

In other words, the feed-water heater virtually gives you nine boiler hp. for nothing. It utilizes the steam that would otherwise go to waste. Or, if your present boiler is a 60-hp. unit, and if you add the above heater, you can then get 69 hp. out of the boiler without burning any more fuel.

Besides, the chart does not show the additional saving due to keeping scale out of the boiler. This saving often amounts to 25 percent in itself. That, also should be considered.

The range of the chart, it will be noted, is great enough to handle the conditions in any ordinary small or large plant. Six hundred hp. saved is the maximum.

Bureau of Mines Analyzes Rodessa, Louisiana, and Oxford, Kansas, Crude Oils

THE crude oil produced from the discovery well in the new oil field at Rodessa, Caddo Parish, Louisiana, is a paraffin base oil, according to the method of classifying crude petroleum with respect to base, devised by the United States Bureau of Mines, Department of the Interior. The bureau's laboratory analysis of a sample of oil from the I. L. Young well No. 1 indicates that the crude oil contains approximately 32 percent of gasoline and naphtha, 20 percent of kerosene distillate, and 25 percent of gas oil and heavier distillates suitable for use as fuel oil or for cracking.

Natural gas has been produced in the Rodessa field for a number of years. The oil-producing formation in the field is found at a depth of approximately 6000 ft. below the surface in what is reported by geologists to be the Upper Trinity (Glen Rose lime). The Rodessa gas field is at the junction of the boundaries of Louisiana, Arkansas, and Texas. Present belief regarding structural conditions has resulted in prospecting into Texas and Arkansas.

If the oil-producing portion of the field should be found to extend into these adjoining states, a major problem of co-operative regulation pertaining to development, including well spacing, and proration of production may be presented, for this would be the first instance of a single producing reservoir in which three states are involved.

The approximate summary of the analysis of the crude oil is as follows:

APPROXIMATE SUMMARY

	Percent	Sp. gr.	°A.P.I.	Viscosity
Light gasoline	6.1	0.692	73.0	
Total gasoline and naphtha	32.1	.738	60.2	
Kerosene distillate	20.0	.792	47.2	
Gas oil	11.9	.830	39.0	
Nonviscous lubricating distillate	12.8	0.838–0.860	37.4–33.0	50–100
Medium lubricating distillate	2.7	.860– .865	33.0–32.1	100–200
Viscous lubricating distillate	.....	.....	.....	Above 200
Residuum	18.9	0.911	23.8	
Distillation loss	1.6	.....	.....	

The detailed analysis of the crude oil is given below:

GENERAL CHARACTERISTICS

Specific gravity 0.808 — A.P.I. gravity 43.6 deg. fahr.

Percent sulphur 0.18 — Pour point 25 deg. fahr.

Color: dark green

Saybolt Universal viscosity at 77 deg. fahr. 40 seconds

Saybolt Universal viscosity at 100 deg. fahr. 38 seconds

DISTILLATION, BUREAU OF MINES HEMPEL METHOD

Dry distillation		Barometer 745 mm.			First drop: 44°C. (111°F.)		
Temperature °C.	Per cent cut	Sum per-cent	Sp. gr. of cut	°A.P.I. of cut	Viscosity at 100°F.	Cloud test °F.	Temperature °F.
Up to 50							Up to 122
50– 75	1.9	1.9					122–167
75–100	4.2	6.1	0.692	73.0			167–212
100–125	6.3	12.4	.728	62.9			212–257
125–150	7.0	19.4	.743	58.9			257–302
150–175	6.7	26.1	.754	56.2			302–347
175–200	6.0	32.1	.769	52.5			347–392
200–225	6.1	38.2	.779	50.1			392–437
225–250	6.4	44.6	.789	47.8			437–482
250–275	7.5	52.1	.805	44.3			482–527
Vacuum distillation at 40 mm.							
Up to 200	4.9	4.9	.825	40.0	40	20	Up to 392
200–225	7.7	12.6	.833	38.4	45	35	392–437
225–250	4.5	17.1	.843	36.4	55	55	437–482
250–275	4.8	21.9	.851	34.8	70	70	482–527
275–300	5.5	27.4	.860	33.0	100	85	527–572

Carbon residue of residuum 4.3%. Carbon residue of crude 0.8%.

The oil produced from the newly-discovered lower horizon in the Oxford field, Sumner County, Kansas, is a high-grade wax-bearing intermediate-base oil, according to the method of classifying crude petroleum with respect to base, formulated by the United States Bureau of Mines, Department of the Interior. The bureau recently has made a laboratory analysis of a sample from the Gassoway No. 1A well, completed by the Amerada Petroleum Corporation and Sunray Oil Company on September 12, 1935. The analysis indicates that the oil contains approximately 32 percent of gasoline and naphtha, 12 percent of kerosene distillate, and 12 percent of light gas oil suitable for use as fuel or for cracking. Heavier distillates may be suitable for manufacture of lubricants, or they may be better adapted for cracking or for use as fuel. The sulphur content of the crude oil is low.

Discovery of oil in the lower horizon at Oxford, at depths of approximately 2800 ft., has had a marked effect upon the total potential production of oil fields in Kansas. The Gassoway No. 1A well is reported to be the largest well in point of initial production that has been drilled in Kansas.

The approximate summary of the analysis of this crude oil is as follows:

APPROXIMATE SUMMARY

	Percent	Sp. gr.	°A.P.I.	Viscosity
Light gasoline	9.1	0.681	76.3	
Total gasoline and naphtha	32.5	.736	60.8	
Kerosene distillate	12.2	.812	42.8	
Gas oil	16.3	.846	35.8	
Nonviscous lubricating distillate	10.6	0.865–0.887	32.1–28.0	50–100
Medium lubricating distillate	6.2	.887– .899	28.0–25.9	100–200
Viscous lubricating distillate	1.4	.899– .902	25.9–25.4	Above 200
Residuum	18.4	0.957	16.4	
Distillation loss	2.4	.....	.....	

The detailed analysis of the crude oil is given below:

GENERAL CHARACTERISTICS

Specific gravity 0.830 — A.P.I. gravity 39.0 deg. fahr.

Percent sulphur 0.21 — Pour point below 5 deg. fahr.

Color: greenish black

Saybolt Universal viscosity at 77 deg. fahr. 42 seconds

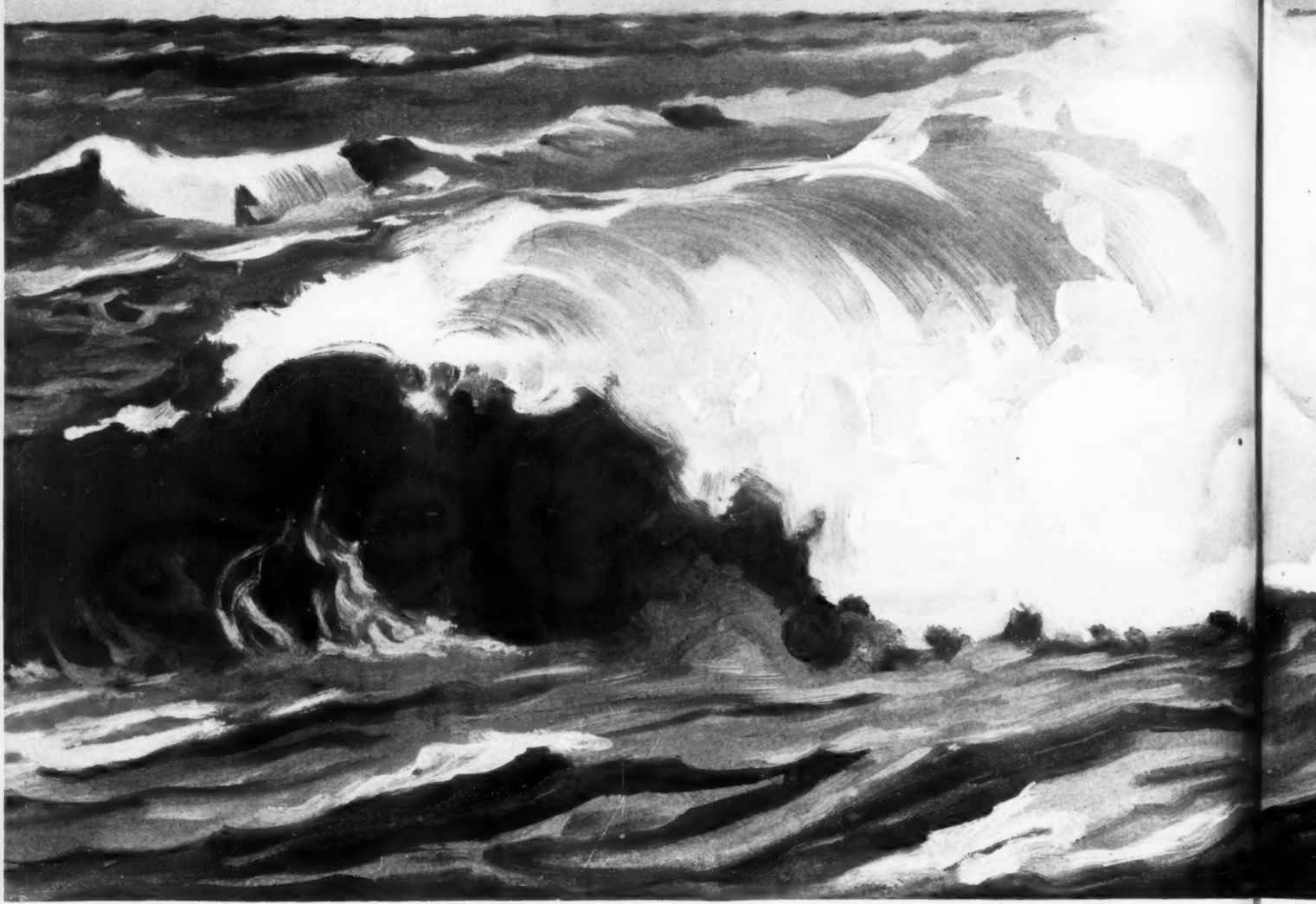
Saybolt Universal viscosity at 100 deg. fahr. 39 seconds

DISTILLATION, BUREAU OF MINES HEMPEL METHOD

Dry distillation		Barometer 746 mm.			First drop: 34°C. (°93F.)		
Temperature °C.	Per cent cut	Sum per-cent	Sp. gr. of cut	°A.P.I. of cut	Viscosity at 100°F.	Cloud test °F.	Temperature °F.
Up to 50							Up to 122
50– 75	4.3	4.3	0.663	81.9			122–167
75–100	4.8	9.1	.697	71.5			167–212
100–125	5.7	14.8	.727	63.1			212–257
125–150	6.4	21.2	.750	57.2			257–302
150–175	6.0	27.2	.769	52.5			302–347
175–200	5.3	32.5	.788	48.1			347–392
200–225	5.8	38.3	.805	44.3			392–437
225–250	6.4	44.7	.819	41.3			437–482
250–275	7.4	52.1	.832	38.6			482–527
Vacuum distillation at 40 mm.							
Up to 200	4.6	4.6	.852	34.6	42	10	Up to 392
200–225	6.1	10.7	.862	32.7	47	25	392–437
225–250	5.6	16.3	.875	30.2	61	45	437–482
250–275	5.5	21.8	.886	28.2	93	65	482–527
275–300	5.3	27.1	.897	26.3	180	90	527–572

Carbon residue of residuum 9.8%. Carbon residue of crude 1.8%.

The Wave of Acceptance



IN 1931, casing was first produced by the A. O. Smith Corporation. On December 5, 1931, the first string of slip-joint casing was run welded in Lloyd No. 90 at Ventura for the Associated Oil Company.

The Wave of Acceptance was forming, soon to swell to great surges before the powerful drive of another great advance in steel—just as it did for those other great advances so important to the oil industry:

Smithwelded Cracking Stills in 1925

Smithwelded Line Pipe in 1927.

A. O. SMITH CORPORATION, *Milwaukee, Wisconsin*

Making Steel work for you as it never did before

Manufactured under
U. S. Patent No. 1,993,842

HIGH-YIELD CASING

MORE FOR YOUR MONEY — HIGH YIELD CASING — LOWER-COST WELLS . . .

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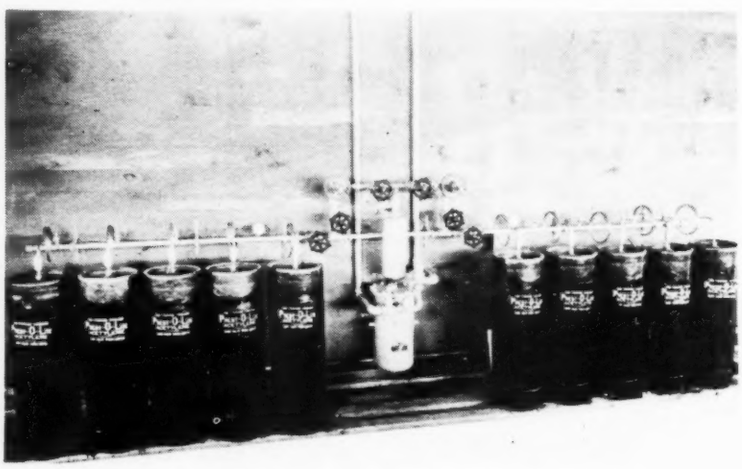
Acetylene Cylinder Manifold

A NEW wall type acetylene cylinder manifold, the Oxweld Type M-8, has been announced by The Linde Air Products Company, 30 East 42nd Street, New York, N. Y. It is available in a ten-cylinder unit to which extensions in units of five cylinders or ten cylinders can be made. The new manifold has been accepted by Underwriters' Laboratories for listing under their Reëxamination Service.

The Oxweld Type M-8 Acetylene Manifold consists of two high-pressure header units. These feed into a central regulation system that delivers acetylene to the distribution piping system at pressures up to 15 lb. per sq. inch.



The Oxweld Type M-8 wall type acetylene cylinder manifold as installed

The header unit assemblies are composed of heavy seamless steel tubing with forged steel union connections having stainless steel seat inserts. Header valves for cylinder connections are of heavy construction and are threaded directly into the steel tubing header. The extreme ends of the header assembly are closed with forged steel caps. Connections from the header valves to the cylinder valves are made with flexible leads. Each is coiled to provide sufficient flexibility, fitted with an approved Prest-O-Lite Flash Arrester and is provided with a ball check valve in the header end. This guards against the possibility of acetylene from the header being driven back into an exhausted cylinder.

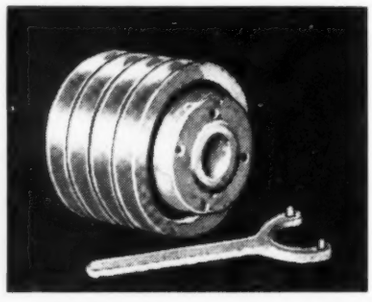
The two high-pressure header assemblies are connected by forged steel unions to a central system of six valves and two regulators for controlling the operation of the manifold. These regulators have been designed for heavy-duty service, and will handle a wide variation in load with less effect on the delivery pressure than would ordinarily be expected.

The pressure in each header is indicated on Oxweld high-pressure acetylene gauges placed on the headers near the union connections to the regulator assembly. A low-pressure gauge attached to the outlet of the hydraulic back-pressure valve indicates the delivery pressure to the shop piping system. The acetylene manifold should be installed in accordance with the regulations of the National Board of Fire Underwriters for the Installation and Operation of Gas Systems for Welding and Cutting. An instruction booklet is provided.

Vari-Pitch Texrope Sheave

THE Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, now offers a new development in power transmission known as the Vari-Pitch Texrope sheave. By means of a simple adjustment that requires but a few moments to make, the pitch diameter of this new sheave can be changed to give variations in speed as high as 15 to 25 percent per sheave. If both sheaves of a drive are of this new type the range of variation can be doubled, the manufacturers state.

These Vari-Pitch sheaves are made in two multi-groove types, stationary and motion controlled. The stationary controlled type is recommended for applications that require occasional change of speed. The motion controlled type is recommended for applications that require frequent quick changes within the full range while the drive is in operation.

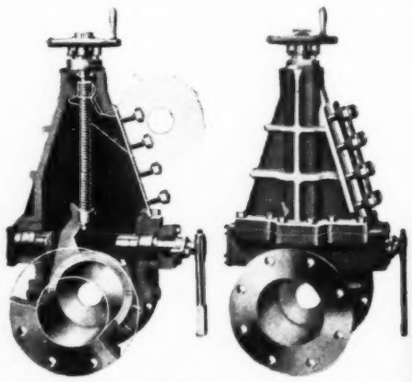


The new Vari-Pitch Sheave drive, which uses texrope belts, retains all the inherent advantages of the texrope drive and will find useful application to a wide variety of industries having variable speed requirements, it is claimed. It permits higher or lower speed operation according to the respective product range requirements of the driven machine. The Vari-Pitch Sheave is especially desirable for V-belt drives formerly employing several sets of sheaves to meet the occasional changes in speed, the makers point out.

Robinson Orifice Fitting

A NEW orifice fitting for handling gases and liquids is announced by Robinson Orifice Fitting Company, Los Angeles, California. The main operating mechanism, entirely enclosed in the upper chamber, consists of a heavy stationary screw and a follower nut, pivoted to the orifice plate carrier. This simple device raises or lowers the orifice plate carrier and forces the carrier into its position in the lower seats. When the plates are to be inspected or changed, the carrier is lifted completely out of the upper chamber and is held in a convenient position for servicing.

The valve seats are covered in both open and closed positions. A full-floating plug valve is lubricated with an equalized pressure system. It is never necessary to lift the carrier manually because it is supported at all times. The orifice fitting has a quick change cover plate. Positive control of the orifice plate is maintained under all pressures. An indicator definitely shows the operator when the orifice plate is positioned in the pipe line bore. The orifice plate may be locked in place, preventing unauthorized changing of orifice plate setting.



Announcing ... No. T128 S

CONTINENTAL-FALK TWIN CRANK UNITARY PUMPER

- 128-CH Continental-Falk Single Reduction Symmetrical Unit
- 360,000" lb. at 20 SPM—Peak Torque Rating
- 73 HP @ 20 SPM—Nominal Horse Power Rating
- Herringbone Gears
- 26,450 lb. API Capacity Walking Beam
- Retractable Walking Beam
- Enclosed Weatherproof Oil Bath Bearings
- Roller Bearing Pitman Heads
- Vertical Tripod Samson Post
- Twin Rotary Balances having constant counterbalance effect regardless of length of stroke
- 24" to 74" Stroke in increments of 5 in.
- Heavy Main Skid Member

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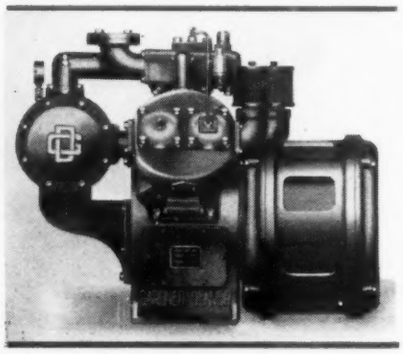
CONTINENTAL

Gardner-Denver Three-Cylinder Air Compressors

AVAILABLE in sizes ranging from 113 to 194 cu. ft. per minute displacements, a new line of three-cylinder air compressors, known as "WBR" is announced by the Gardner-Denver Company, Quincy, Illinois. These new compressors, which are part of the complete WB line, combine a number of unusual features of design that,



Gardner-Denver officials state, materially increase their efficiency and value.

One of the most distinctive features of the WBR compressor is the use of two small low-pressure cylinders, instead of one large one, resulting in lower air temperature with corresponding saving in hp., it is stated. Cylinder walls are water-cooled to provide lower wall temperature with better lubrication and longer life, Gardner-Denver engineers say. In addition, the two-stage construction, with water-cooled cylinders and intercooler, assures sustained high efficiency, it is claimed.

A force feed pressure lubrication system is used, oil being delivered to the bearings by a plunger pump. Pistons and cylinder walls are lubricated by the oil spray of the crank pin. The compressor may be run in either direction.

The main bearings are of the Timken heavy-duty, tapered roller type. This use of roller bearings, according to the maker, decreases the distance of the center of the main bearings to the center of the crank pin, making possible the use of the most compact and rigid crank shaft.

The crank shaft itself is of chrome-nickel-molybdenum alloy, ground to size and accurately counterweighted for best running balance. Connecting rods are of drop forged steel, heat treated, having steel-backed, babbit-lined, ribbon-type crank pin bearings. Pistons are of the light weight automotive type, ground to fit the cylinder bore, and three compression and one oil ring are used on each piston. Valves are of the "cushioned" noiseless automotive plate type, the cushioning being accomplished by the use of an air cushion pocket in the guard or bumper over each valve.

Thermoid BX Woven Industrial Brake Lining

THE perfection of a new type of brake lining, called Thermoid BX Woven, for use on heavy industrial machinery and equipment, is announced by the Thermoid Rubber Company, Trenton, New Jersey. This brake lining has as its base asbestos tape that is woven in a single thickness and, therefore, has no plies to separate under severe service conditions. This tape is woven of heavy yarn containing brass wire and is impregnated with a highly heat-resistant Bakelite resin. The resultant product is a dense, flexible material consisting of 70 percent asbestos and 30 percent resin. It is ground on the wearing surface, ready for application.

Thermoid BX Woven Brake Lining has a very high coefficient of friction under all conditions of service; gives quick deceleration and "high holding." It will stand heats above 900 deg. fahr. without deteriorating; neither is there any deterioration nor material decrease in efficiency in the presence of oil, grease or water, the manufacturers state. BX flexes quickly to the drum flanges and does not score them.

Recommendations for usage of Thermoid BX Woven Brake Lining are dictated by service conditions rather than by types of machinery or equipment. In general, it is recommended for services that involve fast deceleration and moderately high heat factors. Such conditions are encountered on drawworks, sand reels, winches and clutches.

This same type of brake lining with several changes in the formula and construction is also offered by Thermoid for use on heavy duty trucks and buses.

The addition of BX Woven rounds out a complete line of Thermoid braking materials for all industrial purposes. Other type materials are Thermoid Hydraulic Compressed Brake Lining and Thermoblocks, and the three types cover the full range of frictions and heat factors of industrial services.

General-Purpose Automatic Time Switches

WIDE adaptability, simplicity, reliability, and low-cost installation and maintenance are the features that characterize the new Types T-17 and T-27 automatic time switches now available from the General Electric Company, Schenectady, New York. These switches are suitable for all general-purpose applications.

The Type T-17 time switch will control almost any electric circuit on a schedule related to the time of day. It will perform any practical number of operations per day and can be set to skip one or more days if desired, the manufacturers state. The standard switches are designed for a-c. circuits, 115 and 230 volts. The current rating is 40 amperes per contact. The triple-pole switch will handle 120 amperes, split load, thus saving the cost of additional contactors. Either a plain dial (for fixed time setting) or an astronomic dial (for sun schedules) or certain combinations of both can be furnished.

The Type T-27 time switch is similar to the Type T-17 except that it is not equipped with a weatherproof case or with an omitting device for selected days, such as Sundays and holidays. It is for indoor service only.

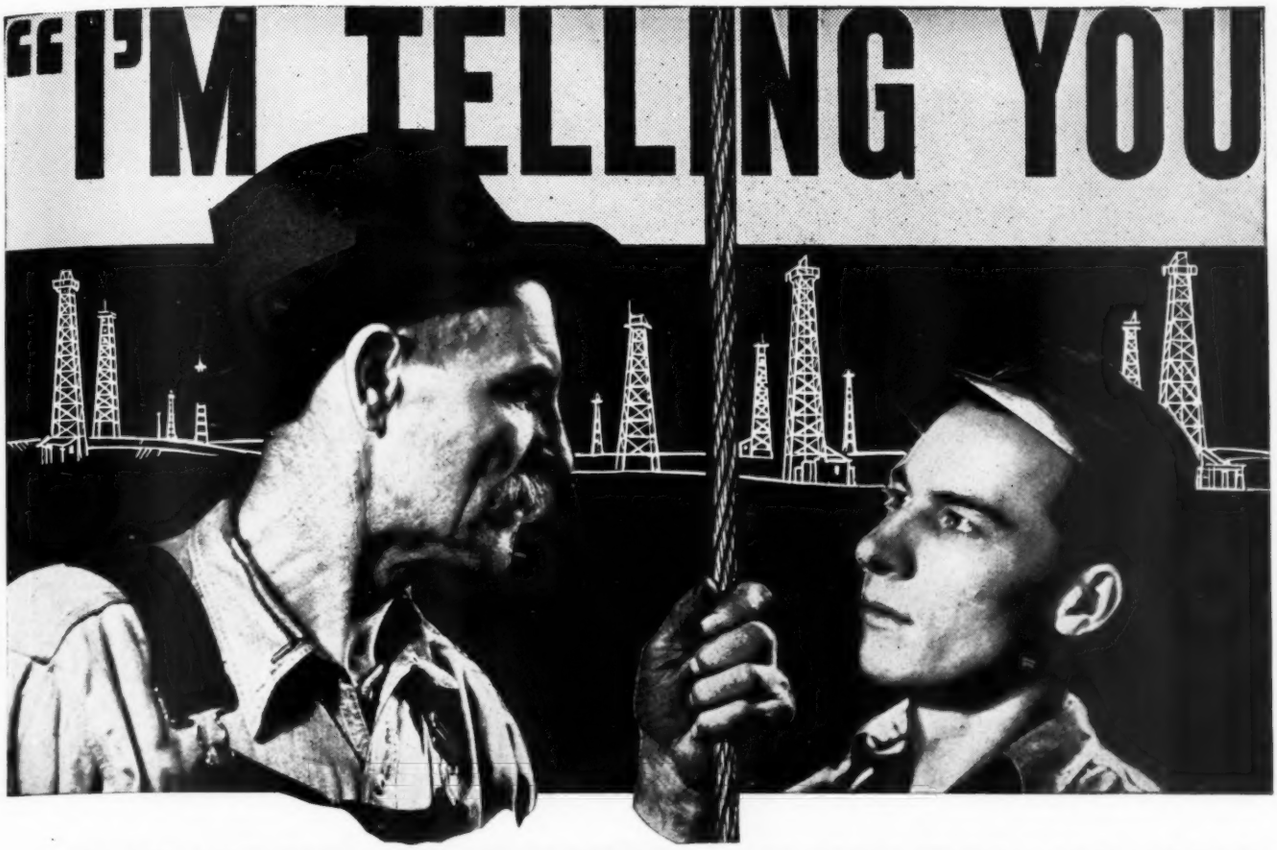
In both types, the drive is direct from a Telechron motor through a compact spur-gear train. The switching mechanism is unusually simple and operates quick-make and quick-brake silver contacts. Installation is easy and is accomplished without removing the mechanism from the case.

The switch is operated by small riders clamped to the periphery of the time dial at selected points by means of thumbscrews. These riders, any number of which may be used, within limits, engage the tripping lever of the switch. The switch itself consists of a ratchet-operated cam actuated by an operating spring and alternately forces the contact buttons apart and allows them to close. The mechanism is provided with an index that indicates the position of the switch.

As regularly supplied, the Type T-17 time switch can be set to omit switching operations on one or more days of the week as desired. The setting for this purpose is accomplished by means of small screws that may be turned in to the proper point on a day wheel to cause the required omissions.

These time switches are available in six forms: Single-throw—single-, double-, and triple-pole; double-throw — single- and double-pole; and two-circuit with separate break. The T-27 is for indoor use, while the T-17 is for either indoor or outdoor use. The standard switches are for operation in a temperature range of from zero to 110 deg. fahr., although if specified, special switches for operation in a temperature range from —20 to 110 deg. fahr., will be supplied at no additional cost, it is stated.

"I'M TELLING YOU



..THAT IT COST ME A LOT TO LEARN ABOUT WIRE LINES"

"EXPERIENCE is priceless they say—and I'm telling you that it cost me a lot of time and money to learn about Wire Lines. I've tried about every brand there is, I guess, searching for low operating costs and for one source that I could depend upon to best meet every need for drilling and production. Like most other old timers, I'm sticking as fast as glue to Tiger Brand Wire Lines—won't use anything else—because they never fail to come through smiling—to do better work at less cost. I'm telling you, also, that the service back of them is the best I ever experienced."

AMERICAN STEEL & WIRE COMPANY

TIGER BRAND WIRE LINES

REG. U. S. PAT. OFF.

AMERICAN STEEL & WIRE COMPANY

208 S. LA SALLE STREET, CHICAGO • • EMPIRE STATE BUILDING, NEW YORK

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco

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Export Distributors: United States Steel Products Company, New York

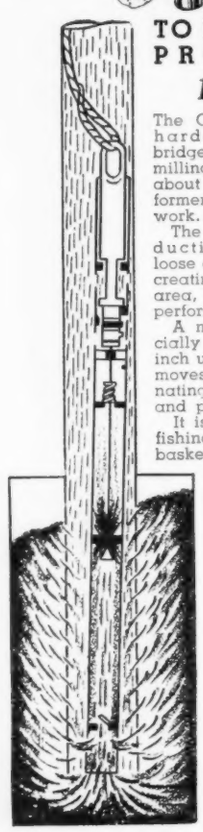
United States Steel Corporation Subsidiary

DON'T GAMBLE

the vast sums of money invested in producing oil sands against the nominal cost of cleaning out efficiently.

USE CAVINS *THE*

3 Tools *In One*



TO KEEP WELLS PRODUCING

Profitably

The CAVINS breaks the hardest packed sand bridges, removing sand, millings and cuttings in about one-third the time formerly required for this work.

The CAVINS raises production by removing all loose and packed sand and creating a larger drainage area, and by cleaning the perforations thoroughly.

A model designed especially to run inside of 2½-inch upset tubing easily removes sand bridges, eliminating the hazard of killing and pulling flowing wells.

It is unequalled as a fishing tool. With a junk basket or trap attached to bottom The CAVINS will easily recover such articles as cones, rollers, discs, slips, and pieces of iron, rubber, rope and wood.

The CAVINS cleans out sand around and inside the "fish," permitting a socket or suitable fishing tool to get hold of it.

Write for illustrated bulletin containing detailed description of The CAVINS — the most valuable protection for producing wells.

THE CAVINS COMPANY

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Foreign Representative: R. J. Eiche
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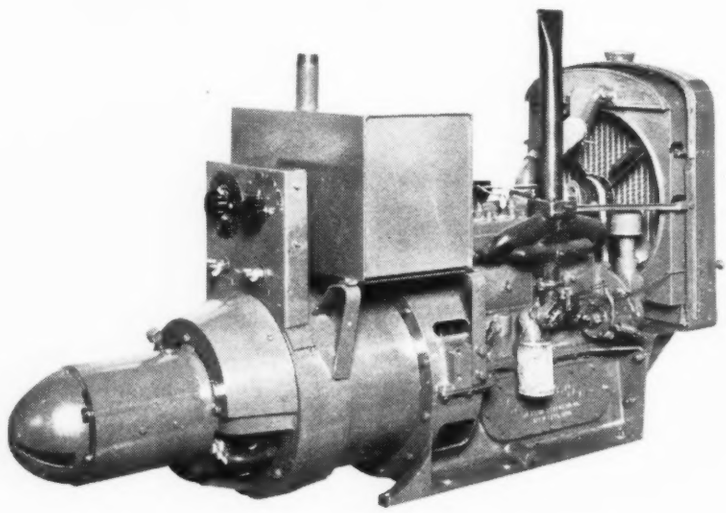
3800 Chester Ave., Bakersfield, Calif. Phone 1779-J
200 Center St., Taft, Calif. Phone 78
Goleta, Calif. Phone 8213
Santa Paula, Calif. Phone 234
Houston, Texas. Phone Wayside 1451
Kilgore, Texas. Phone 753
Pampa, Texas. Phone 1220
Oklahoma City, Okla. Phone 3-6441
Wichita, Kansas. Phone 45-449
Lyons, Kansas. Phone 227

Low-Priced Engine-Driven Welder Announced by Lincoln

A NEW 200-amp. special engine-driven "Shield Arc" welder is announced by The Lincoln Electric Company, Cleveland, Ohio. According to the manufacturers it is the lowest priced welder of this type ever placed on the market. This new model, known as the "200 ampere Shield Arc Special", supplies a uniform current for welding with bare or heavily coated shielded arc type electrodes in all sizes up to ¼ inch. The welding current range of this new machine is from 60 to 250 amperes. Its generator is the single operator variable voltage type with completely laminated magnetic circuit and equipped with interpoles. It requires no external reactance or stabilizer. The patented Lincoln dual control of welding current is provided by adjustment of both series and shunt fields. Separate excitation of the generator shunt fields is supplied by an exciter connected on the generator end of the unit. A generator field rheostat and a current regulating switch are mounted in vertical position on a "dead-front" steel control panel. Electrode and ground cable connections of the wing nut type also are in an easily accessible position.

The welder is powered by a Waukesha 4-cylinder engine that delivers 23 hp. at 1400 r.p.m., the speed at which the welder is operated. A gear-driven governor maintains proper engine speed at all load conditions. The engine is equipped with standard high-tension magneto and vertical-type carburetor with air cleaner. Gasoline tank of ample capacity for a full day's operation is mounted over the generator. The engine is direct-connected to the generator shaft. Due to this close-coupling feature, the unit is compact and weighs only 1078 pounds. This new low-priced welder sells for $695.00 F.O.B. Cleveland, Ohio, with freight allowed to destination.



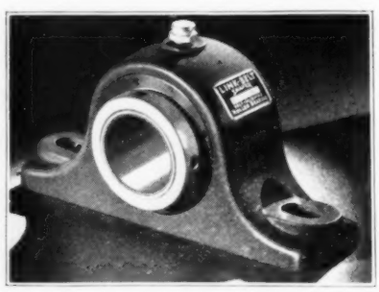
Self-Aligning Roller Bearing Units Announced by Link-Belt

ANNOUNCEMENT is made by Link-Belt Company, Chicago, Philadelphia, San Francisco, that it has developed a new line of bearing units, known as Link-Belt Shafer self-alinging double-row roller bearings are used in Link-Belt mountings, said to make an excellent combination for general service. These units are available for pillow blocks, flange bearings, hangers, and take-ups.

The advantages of the new combination are pointed out as: 1. Ability to carry (a) radial loads, (b) thrust loads, (c) radial and thrust loads combined. 2. Inherent self-alignment.

Self-alignment of the Shafer roller bearings is provided by concave rollers between convex outer races and a spherical inner race on the sleeve, which is free to deflect with a shaft temporarily misaligned or out of line because of inaccuracies of installation. The rollers travel in a true path on accurate races. Labyrinth seals protect the bearings. Bores are ground for direct shaft application.

The dimensions, radial load capacities, list prices and other data on these new roller bearings are given in a new book No. 1494, a copy of which may be had by addressing Link-Belt Company, 300 West Pershing Road, Chicago, or the nearest office of the company.



Shafer Self-Aligning Roller Bearing "Series 400," and that stocks of these bearings, in the popular standard sizes, are now available.

U. S. Royal Cord Belt

THE U. S. Royal Cord Belt, a new cord transmission belt, is announced by the Mechanical Goods Department of U. S. Rubber Products, Inc. It is the outcome of improvements and refinements of the present U. S. Cord Belt with its encasing duck envelope, and U. S. Royal Cord Belt at last presents one that will meet the whole range of transmission problems, according to the manufacturers.

The most striking characteristic of this new addition to the U. S. line of mechanical goods, is the square cut edge, in which respect, as well as in its coloring of mahogany with blue edges, it resembles the U. S. Royal (Duck) Belt that for so many years has impressed these characteristics as the mark of advanced practice in belting. Due to the cords being embedded in rubber, the cut edge in U. S. Royal Cord Belt has proven its value when run against shifters.

The laminated and cut edge construction permits the use of a single ply of duck on either side instead of the several plies in the envelope type. The manufacturers state that since the efficiency of a ply of cord fabric in the carcass is much greater than that of a duck ply in the cover, it will be realized what an advantage in strength is gained when such substitutions are available in the same number of plies, of course, at no additional expense.

Recognizing the disadvantage of the many seams in the bias cut duck cover, U. S. has developed a special duck to eliminate these, requiring but one cover joint, and due to an improved method of making this joint, it is, the makers say, as perfect an endless belt as can be constructed.

The new belt is available in widths up to 24 in. and in plies from five up.

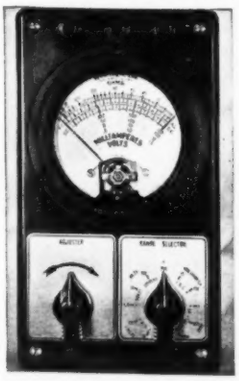
Admore Insert Pump Anchor of Bradford Motor Works

THE BRADFORD MOTOR WORKS, INC., of Bradford, Pennsylvania, announce a perfected combination packer and hold-down for seating the Admore and other insert pumps at any desired point within the tubing, thus making it possible to pump from any desired level without the necessity of pulling or moving the tubing. No common working barrel or seating device is needed.

The Admore Insert Pump Anchor replaces the conventional hold-down arrangement on the Admore pump. It is sturdily constructed and very simple, consisting of a tube on which is mounted a specially designed slip assembly and expander sleeve, and onto which is screwed the bottom collar and tapered head with rubber packer. The slip assembly arrangement is such that the possibility of accidental setting, while running into the hole, is eliminated, yet it is possible to set easily when the desired level is reached. When the slips are set the downward travel of the expander sleeve is stopped, and the weight of the rods, when set down on the anchor, drives the tapered head into the rubber packer. The head seizes in the packing so that a considerable pull is required to unseat the anchor.

This unit, in common with all B-M-W products, is now available at all supply stores serving the oil industry.

Angle Switching Equipment Controls Compressor Motors



ANGLE switching equipment for controlling large synchronous motor-driven reciprocating pumps and compressors to prevent the compression strokes on different units occurring in unison has been developed by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania. Employing an electronic tube, this new device effectively reduces the magnitude of current pulsations where two or more drives are used. Minimum pulsations are desirable to reduce flicker in lights and interference with the operation of other electrical equipment.

"QUINTUPLEX"
STANDS OUT AS THE GREATEST SINGLE AID TO MODERN ECONOMICAL DRILLING
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LONG BEACH
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SAN JOAQUIN VALLEY: A. F. McQUISTON, OILDALE, CALIFORNIA
MID-CONTINENT DISTRIBUTOR: REED ROLLER BIT CO., HOUSTON, TEXAS

Safety and Improved Gasket in New Enardo "Cantilever" Tank Valve

COMBINING a safety valve that affords automatic inspection every time the lid is opened and a flexible resilient gasket that eliminates the usual softening, the Enardo Manufacturing Company of Tulsa, Oklahoma, is marketing four types of "Cantilever" tank valves made on a new principle.

The "Cantilever" is made in both round and long types. The round type has two models, a 2-in. base and a 10-in. base for water-seal tanks. The long type, with a valve and thief-hatch combination, is also made in the 2-in. and 10-in. base for water-seal tanks.

The tall base eliminates the necessity of installing an iron collar on water-seal tanks. The long type has a rest for the thief inside the opening, thus avoiding waste of oil and drippings on the roof. All models are made in stove-plate gray iron.

Ice and dirt will not gather on the valve gasket as it is in the lid. The gasket is felt-backed, gasoline and oil-proof cork fibre. There is little danger of the valve being held open or freezing shut, the manufacturers state.

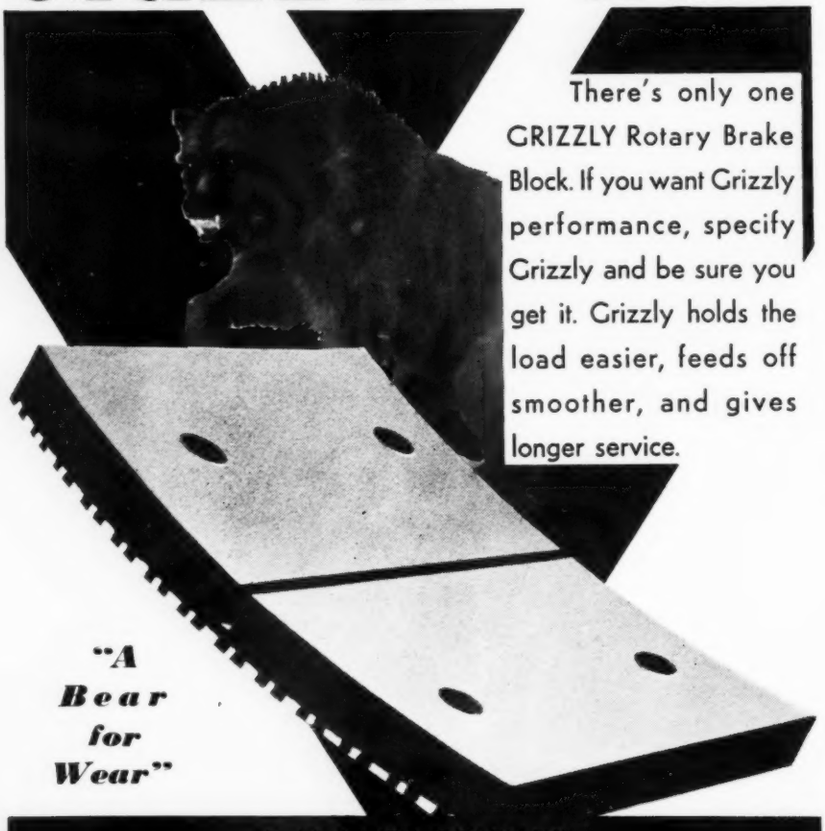
The thief-hatch opening on the round type is eight in. in diameter and on the long type is 7¾ in. by 17½ inches. The valve inside the lid is 5½ in. in diameter and is sufficiently large to take care of normal breathing on tanks for which it was designed.

Valves are furnished for one-half ounce vacuum and a pressure of two ounces or any other specifications needed.

ORDER THEM BY

Name Only

GRIZZLY FULL-MOULDED BRAKE BLOCKS



There's only one GRIZZLY Rotary Brake Block. If you want Grizzly performance, specify Grizzly and be sure you get it. Grizzly holds the load easier, feeds off smoother, and gives longer service.

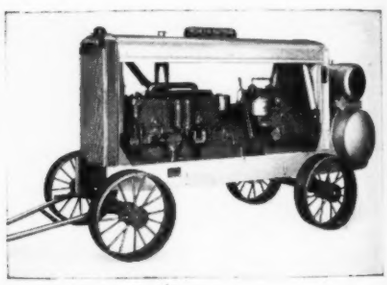
"A Bear for Wear"

E. M. SMITH COMPANY
600-650 South Clarence Street, Los Angeles, California, U. S. A.
Export Office: Continental Emsco Company, 30 Rockefeller Plaza, New York City.
Sold in the Mid-Continent and Gulf Coast by: Continental Supply Company; and T. T. Word Supply Company, Inc., Houston, Texas — In All Their Stores.

Portable Air Compressors by Worthington

FOUR models of Aero-2-Stage portable compressors for delivering 105, 160, 210, and 315 cu. ft. of actual air per minute (A.S.M.E. standard test), for use wherever a mobile compressed air plant is needed, are now offered by the Worthington Pump and Machinery Corporation, Harrison, New Jersey.

Advanced design features throughout insure highest efficiency and endurance with delivery of the greatest volume of air at lowest fuel and maintenance cost, the manufacturers state. For example, the 105, 160, and 210 models are compact, convenient and complete compressed air plant units. They are balanced-angle, two-



stage, air-cooled, unit-assembly, with clutch connection to heavy-duty 6-cylinder gasoline engines. Speed, 830 r.p.m. Air pressure, 100 lb. gauge. Bores, strokes, and number of cylinders differ in the various models. The compressors are equipped with improved feather valves, ring-type cooling fins, articulated connecting rods, drop-forged crankshaft, Timken roller bearings, spray and force-feed lubrication, oil filter, and V-belt-driven cooling fan. The engines are Hercules, heavy duty, with 7-bearing crankshaft, removable cylinder sleeves, exhaust valve inserts, permanent oil filter, fuel strainer, roller bearing V-belt-driven fan, and other modern features. Mounting of the unit depends upon requirements and size. Thus the 105 model may be had as follows: skid-mounted; steel wheel; solid rubber or pneumatic tired towabout; four-wheel solid rubber or pneumatic tired spring trailer; two-wheel single-axle spring trailer with solid rubber or pneumatic tires; truck-mounted; power take-off drive; rail car; mine car.

Jarecki Improved Berry Pattern Casing Head

THE new Jarecki Improved Berry Pattern Casing Head, recently placed on the market by the Jarecki Manufacturing Company, is of the high pressure type and suitable for any working pressure for which this style head may be used.

Heavily constructed of semi-steel, the Jarecki Casing Head features set-screws

inclined at such an angle from the horizontal as to be perpendicular to the beveled edge of the top or tubing support, thus eliminating the tendency of the set-screws to bend and break off.

The casing thread conforms to A.P.I. casing thread standards, and is designed exactly like an A.P.I. casing collar. The thread is full length and is recessed. The side outlets have full-length threads. The head is available in all casing sizes, and for any size tubing.

The interior of the head is circular, and there are no shoulders to catch tubing collars. The upper interior edge is beveled to prevent catching collars when rerunning tubing.

The exterior of the Jarecki Head is circular, the edges of the side-outlet bosses serving as convenient gripping points, for chain tongs when screwing onto casing.

The set-screw flange of the head is provided with tapped drain holes to drain oil or water out of the space around the top or tubing support.

A request to the Jarecki Manufacturing Company, Tulsa, Oklahoma, will bring a descriptive pamphlet on the Jarecki Head and any additional information desired.

Hancock Globe Valve

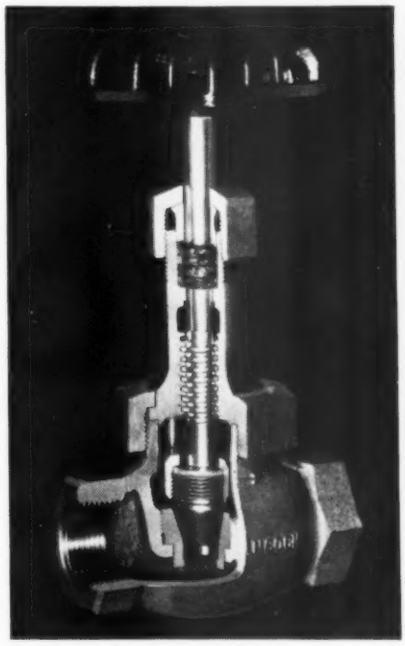
A NEW union bonnet bronze globe valve has been developed by the Hancock Valve Division of the Consolidated Ashcroft Hancock Company. This new Hancock Valve has a number of advanced features that, it is claimed, greatly increase its wearing qualities. These advancements include superhard stainless steel valve disks and seat rings (hardened to 500 Brinell), said to prevent wire drawing, steam cutting, and galling.

The disk is attached to the stem in a new way that insures correct seating and facilitates regrinding.

Special types of bronze have been developed for the valve stem and bonnet that the makers claim greatly lengthen the service life of this valve.

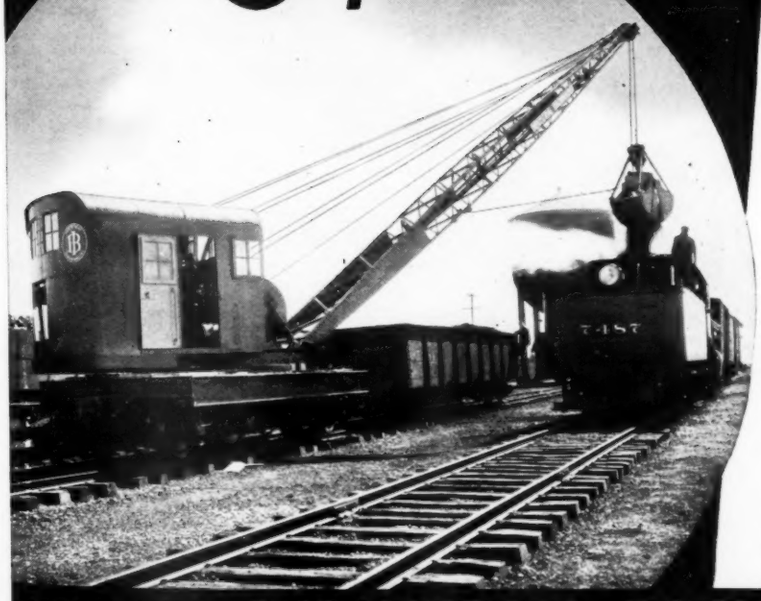
A distinctive design provides tight backseating and permits easy repacking while the valve is in pressure service. Made for steam pressures up to 300 lb., these new bronze valves are available in both globe and angle patterns.

The many other features of design and



materials are fully described in a new bulletin that may be obtained by writing to the Hancock Valve Company, 79 Elias Street, Bridgeport, Connecticut.

Why DO RAILROADS prefer THESE CRANES?



More than 2400 Industrial Brownhoists have been bought by the nation's railroads.

These locomotive and crawler cranes were selected on the recommendation of the engineering and operating departments—organizations whose experience with all kinds of material handling problems is seldom equaled. This definite preference is worth remembering whenever the low cost handling of materials is considered.

Industrial Brownhoist cranes are built in capacities of 6 to 200 tons; with gas, steam, Diesel or electric power.

GENERAL OFFICES BAY CITY, MICHIGAN

INDUSTRIAL BROWNHOIST

NEW YORK, PHILADELPHIA CLEVELAND, CHICAGO

MacCLATCHIE VALVES WEAR LONGER AND COST LESS

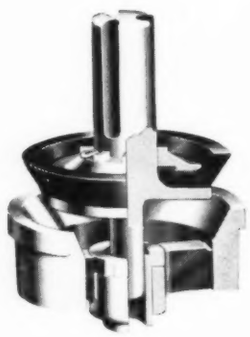
Before purchasing valves compare prices and convince yourself that you can buy MacClatchie Patented High-Quality "Stream-Line" Valves for even less money than most unpatented makes. Standardize on MacClatchie Valves. They are fully protected by patents, insuring freedom from patent litigation.

MacClatchie *"Stream Line"* Valves

MacClatchie "Stream-Line" Valves stand in a class by themselves. The correctness of their design, which has not been changed since they were introduced nine years ago, is shown by the fact that there are more of these valves in use than any other make. Four out of five of the largest operators on the Pacific Coast use MacClatchie "Stream-Line" Valves for 95% of their valve requirements. Only in genuine MacClatchie "Stream-Line" Valves can you obtain the patented feature of greatest importance—streamline construction. The streamline cross bar provides additional striking area which gives LONGER LIFE without flat surfaces or abrupt shoulders obstructing the flow of fluid or leaving any place for sand to collect to impair the proper closing of the Valve. In MacClatchie "Stream-Line" Valves the metal of the seat takes the entire blow, with the rubber insert providing the fluid-tight seal. The insert may be tightened after it has become worn on one side and may be readily reversed for additional wear. The seat and valve proper are each of solid, one-piece construction—the complete valve being readily assembled with nothing to jar loose. To prevent damage to pumps by cutting-out between their ports and valve seats special care is taken to insure the seats fitting tightly in the ports. The seats of MacClatchie Valves are accurately ground to true cylindrical form and each seat is greased, wrapped in oiled paper and packed in a strong carton to make sure that it reaches the user without its surface being rusted or damaged in any manner.

MacClatchie *Monarch* Valves

MacClatchie Monarch Valves are furnished for those operators who demand a cheaper valve (they are priced approximately 15% less than "Stream-Line" Valves). It has a renewable striking guide and also utilizes the cross bar as additional striking surface and is made of the same high-quality material and workmanship as MacClatchie "Stream-Line" Valves. In competitive tests it has outrun other makes of higher priced valves and has consistently given good service. MONARCH VALVES HAVE ALL THE FEATURES FOUND IN OTHER MAKES OF HIGHER PRICED VALVES. Made for any make and size of pump.



MacCLATCHIE MFG. COMPANY

COMPTON, CALIF. » HOUSTON, TEXAS

MUD PUMP VALVES, PISTONS, PISTON RODS, PUMP LINERS AND PLUG VALVES
SOLD BY ALL LEADING SUPPLY HOUSES

Engineering Fundamentals Department

- A Study Course for Field and Plant Men
- A Review for Experienced Engineers

W. L. NELSON
K. C. SCLATER
Editors

Elements of Applied Petroleum Production

By K. C. SCLATER

Article 25

CLEANING-OUT AND REPAIRING WELLS—(Continued)

THE several methods of cleaning-out that have been described might be classed as special methods owing to the limitations of their applicability. There are, however, other clean-out methods and repair practices in more general use.

These vary widely in their application because of the variety of well conditions encountered; from old shallow wells with a bottom-hole pressure of only a few pounds to deep wells in the flush stages of production with a bottom-hole pressure of 2000-3000 pounds.

Old wells in fields of settled production usually have to be cleaned out at regular intervals by bailing, swabbing, or running the tools to keep them producing efficiently. When a regular clean-out schedule is followed, it is generally based on the characteristics of the well as observed from production records.

In the Eastern fields of the United States it is considered good practice to follow a regular clean-out schedule. Clean-out operations become routine and are in many cases accompanied by carbide and water treatment to keep the hole free of gummy or waxy deposits. Wells producing from limestone strata are also treated with acid. Shooting of wells with glycerine is also resorted to in conjunction with the clean-out operation.[93]

The carbide and water treatment is essentially a heating process. Heat is generated by the chemical reaction between the water and the carbide. This heating process is used principally for the removal of gummy or waxy deposits in the well — generally known in the field as "paraffin trouble". Other chemicals are also used for this purpose. All heating processes in which chemicals are used in this manner are somewhat similar in their application and depend on the heat of the chemical reaction for their efficacy.

In the carbide treatment, approximately one bbl. of water is used per 100 lb. of carbide. The size of the hole in the producing formation usually determines the quantity of carbide required. As much as 300 to 500 lb. per charge is used in small wells.[95]

Acidizing is used only in wells where the producing formation is predominantly limestone. The solvent action of the acid on the limestone opens up new channels for the flow of oil into the hole. After shooting, acid is sometimes used, for it reacts vigorously with the fresh surfaces of limestone exposed in the hole by the shot. When used in this manner the acid treatment is frequently quite effective.

It is only within the last few years that the far-reaching effects to be obtained by the use of acid in stimulating production in limestone wells have been generally recognized.[96]

The quantity of acid used, the time of treatment, the number of treatments, and the increase in oil recovery are important factors to be observed to obtain the most effective use of acid.[97] The use of acid is one of the most important aids in recent years for the stimulation of production from oil wells and skill in its application has developed rapidly.

Shooting of the producing sand is often used to increase the production in an oil well. Shooting increases the superficial area of the producing sand exposed in the well. It also removes the old face of the sand, the pores of which may be plugged-up with paraffin wax or gummy deposits of silt. Only in areas where the sand is hard and does not cave easily should shooting be practiced.

Shot holes of wells that cave badly are repaired by the use of gravel. In wells that have been shot several times, caving may cause frequent shut-downs and difficult clean-out jobs. Cavings or sand foul the pumping equipment, eventually resulting in loss of production. In such cases, caving can be prevented by filling the shot-hole with gravel.[98] Well-screened river gravel, ½ to 1 in. in diameter, is suitable for this purpose. The gravel, while holding back the cavings, allows the oil free access to the hole. Wells so repaired have produced for three years and longer without trouble.[95] It is good practice to set a slotted liner or screen on the bottom of the hole so that pumping equipment may be set at any desired depth.

Screens or liners when they plug-up may be back-washed or the perforations cleaned by special tools.[94]

When a well is cleaned out or repaired a record of its rate of production, before and after, should be carefully checked for results. The increased rate of production, if any, should be compared with the clean-out cost. Such in-

TRADE
MARK

formation will be a guide in determining the period between clean-outs that is most economical.

When large quantities of sand, shale, silt, or cavings come into a well, the cause should be ascertained and measures taken to remove it.

The trouble may be due to wrong size of screen or liner, a defective screen or liner, faulty casing, a faulty casing seat, the method of production, or to some obscure condition in the well. The cause of the trouble, whatever it may be, will usually suggest the remedy.

Sometimes water entering the well will be an aggravating cause of sand trouble. In that case, the source of the water should be determined; whether it is coming from the pay sand, the bottom of the hole (if not in the producing sand), a casing leak, or around the casing seat.

Should the trouble be due to a casing leak, the casing may have to be renewed—if the well condition allows and the circumstances warrant it. If the well condition and the circumstances do not warrant running another string of casing, the casing leak might be repaired by cementing behind the casing. This may be done by perforating above and below the leak and setting a special packer in the casing by means of which circulation may be obtained between the perforations. Once circulation is established and the hole behind the casing leak thoroughly washed, sufficient cement to stop the leak may then be pumped behind the casing. If the leak is not serious it might be possible to set a tubing packer in the casing to prevent water entering the well.

A faulty casing seat may have to be repaired by recementing or by setting a packer below the casing shoe if there is no liner or screen in the well, or by packing off the top of liner or screen from the casing shoe if there is a liner or screen in the well.

Water entering from the bottom of the hole may be shut off with cement, or by setting a bottom-hole packer.

Sand coming from the producing formation with the oil may be controlled by setting of a screen or liner opposite the producing sand. The perforations or openings in the liner or screen should be of the proper size and shape to prevent the sand from coming into the hole. The sand accompanying the oil may be so fine that it will be difficult to keep it from entering the well. In that case, if the well is on the pump, the mechanical arrangements, such as a proper type of pump or anchor, should be such as to keep the sand from interfering too much with pumping operations. If the well is a flowing well, the rate of flow may be reduced by means of choke nipples or flow beans. In these days of restricted production, it is seldom that a flowing well is allowed to produce at such a rate that "sanding-up" due to a high rate of flow becomes a problem.

In regard to sand entering a pumping well it is believed to be desirable to produce sand with the oil in a pumping well for maximum ultimate recovery. In producing sands that are not too soft and unconsolidated, and do not have a tendency to pack, or become compacted after the removal of the finer grains carried out with the oil, obviously, the channels for the movement of oil in the pay sand are increased, thereby allowing the oil to flow more freely into the hole. In other words, the permeability of the pay sand is increased. "Experience in 'soft-sand' fields will probably bear out the statement that the wells producing the most sand have a higher ultimate recovery."[99]

The amount of sand allowed to enter a well will be governed by the maintenance cost.

When the upkeep due to sand is excessive the necessity for cleaning-out is apparent. In this connection, the average unit lifting cost of the oil over the entire life of the well should be the governing factor in determining the length of time between clean-outs.

Reconditioning of deep wells is also a phase of clean-out and repair operation that calls for a great degree of skill and the application of modern field practices and equipment.

In deep pumping wells that fall off in production and require reconditioning while the bottom-hole pressure is still high (also occasionally wells that are still flowing naturally), cleaning-out and repair work become formidable tasks. Precautions must be taken and preparations made to keep control of the well while cleaning-out.

On the other hand, the bottom-hole pressure may be so low that cable tools, rather than rotary tools, have to be employed. The reason for this is that with rotary tools, there is danger of mudding-off the face of the pay sand because of the necessity of maintaining circulation while cleaning-out.

Good examples of such hazards are found in the Oklahoma City field[100] and in the fields of the Gulf Coast.[101]

As a preliminary to reconditioning work in the Oklahoma City field, bottom-hole measurements are made to determine the condition of the hole. For this purpose winches and power-driven measuring devices on automotive equipment are employed. Bottom-hole pressures are taken by pressure bomb run on a wire line (Halliburton type); samples of the fluid are taken at the bottom of the hole by means of a sampling bomb run on a wire line; and the depth of the well is determined by measuring the deflection of the hole and applying a correction to the steel line measurement. By having an accurate measurement of the depth the exact amount of cavings in the bottom of the hole is known.

Other preparatory work consists of disconnecting the separator and installing the necessary high-pressure connections for the pump that is used in killing the well. Clean oil (with no water) is then pumped in to kill the well. This precaution is necessary in killing a well in the Wilcox sand in that field; for with water, the sand will not stay in suspension, but settles rapidly, packing around the tools and "sticking" them. A blow-out preventer and lubricator are then placed on the well. The lubricator is long enough to hold a string of tools, so the master gate can be closed with the tools in the lubricator above.

Connections are also installed on the well so that oil can be pumped in, should the well start flowing while cleaning out. During cleaning-out it is the practice to maintain a head of oil on the well slightly greater than the bottom-hole pressure.

●

QUESTIONS

1. Explain the carbide and water treatment and its purpose.
2. How does it differ from acid treatment?
3. How is gravel used for overcoming trouble in shot holes that cave badly?
4. How may a serious casing leak be repaired to prevent water from entering the well?
5. In what respect and under what conditions is it desirable that a pumping well produce sand with the oil?
6. What precautions are necessary in repairing deep wells that have a low bottom-hole pressure?

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Elements of Applied Petroleum Pipe Line Transportation

By C. E. MAIN, Sr.
Engineer, Sinclair-Prairie Pipe Line Company

Article 16

FLOW OF LIQUIDS IN PIPE LINES (Part V)

Pressure Gauge Readings at Gate Plants

EIGHT.—The gauge pressure at each of the gate plants should be known and it may be determined as follows:

The elevation of the hydraulic gradient at station A was previously computed as 2672 feet. The head consumed by the flowing oil in section No. 1, is 683.4 ft., and deducting this from 2672 we get 1988.6 ft. as the elevation of the hydraulic gradient entering gate plant No. 1.

If one-half of the 3.2 ft. is allowed for the drop in the hydraulic gradient at each gate plant due to the gate plant fittings, then 1988.6 — 1.6 = 1987 ft., the elevation of the hydraulic gradient leaving gate plant No. 1.

The difference between the elevation of the pipe at gate plant No. 1, and the two elevations of the hydraulic gradient, will give the pressure heads in feet of liquid being pumped. Then 1988.6 — 1050 = 938.6 ft. and 1987 — 1050 = 937.0 ft., the two pressure heads in feet of liquid at gate plant No. 1.

At gate plant No. 2, we have for the elevation of the hydraulic gradient entering the gate plant, 1987 — 514 = 1473.0 ft., and 1.6 ft. less, or 1471.4 ft., will be the elevation of the hydraulic gradient leaving the gate plant.

The difference between the elevation of the pipe at gate plant No. 2, and the two elevations of the hydraulic gradient, will give 1473.0 — 1110.0 = 363.0 ft., and 1471.4 — 1110.0 = 361.4 ft., as the two pressure heads in ft. of liquid at gate plant No. 2.

Equation 6 will now be used to compute the equivalent gauge pressures for the four pressure heads.

At gate plant No. 1,

$$P = \frac{61.287 \times 938.6}{(131.5 + 38.0)} = 339.4$$

and

$$P = \frac{61.287 \times 937.0}{(131.5 + 38.0)} = 338.8$$

and at gate plant No. 2,

$$P = \frac{61.287 \times 363.0}{(131.5 + 38.0)} = 131.3$$

and

$$P = \frac{61.287 \times 361.4}{(131.5 + 38.0)} = 130.7$$

Then for a pumping pressure of 650 lb. per sq. in. at station A, the gauge pressures at gate plant No. 1, are 339.4 and 338.8 lb., and at gate plant No. 2, the gauge pressures are 131.3 and 130.7 lb. per sq. inch.

Discharges at Other Pressures

Usually it is also desirable to know the amount that can be pumped when this same oil reaches its maximum temperature. It is found from an A.P.I. gravity table that an oil of 38.0 deg. observed gravity at 35 deg. temperature has an observed gravity of 41.6 deg. at 80 deg. temperature. From the temperature-viscosity curve of this oil we find that the viscosity for 80 deg. temperature is 40 SUS, equivalent to 0.0864 kinematic viscosity in poises.

There are two methods that may be pursued in computing the new discharge. One method has just been used, and the other is by the application of Equation 19.

The second method will be used, as it is very much shorter and is mathematically true if the same related exponents are used as were used in Equations 10 and 11 in the first method.

The value of the new effective head for 650 lb. pressure for an oil of 41.6 deg. A.P.I. observed gravity is computed the same as in the third step of the first method, which results in 696 ft. head, an increase of 2 1/3 percent.

When the old and new values of the head and viscosity are substituted in Equation 19, we have:

$$B_1 = 6150 \left[\frac{1696}{1657} \times \left(\frac{.1944}{.0864} \right)^w \right]^{\frac{1}{n}} = 6997.8$$

and the increase in terms of bbl. per 24-hour day amounts to 21,352 bbl. or 13.78 percent, of which 1973 bbl., or 1 1/3 percent, was due entirely to the increase in the effective head caused by the change in the observed gravity of the oil.

Required Length of Loop for a Given Increase in Discharge

It was previously stated that the efficiency of a system of parallel lines depends entirely upon which section the additional pipe is laid, when it is desired to increase the discharge of a district by laying additional pipe in one of the sections.

When a pumping district has two or more equally spaced gate plants, any desired increase in discharge of the district can usually be obtained by laying either an 8-in., 10-in., or 12-in. loop in the proper section of the district without putting in an additional gate plant.

For illustrating the method of computing the required length of a loop to lay for a given increase in discharge, when the length of the pipe is less than the length of the section in which the additional pipe is to be laid, let us assume a small increase in discharge from 6150 to 6345 bbl. per hour for the same station district that is diagrammatically shown in Fig. 2.

From what has been previously explained it is obvious that the proper location of any additional pipe is in section No. 1, if the efficiency of all the pipe in the district is to be improved.

Location of a Loop Within a Section

The question as to the location of the new loop within the section is immaterial whether it started at station A, ends at the gate plant, or whether it starts and ends at some intermediate point within the section, provided a by-pass of

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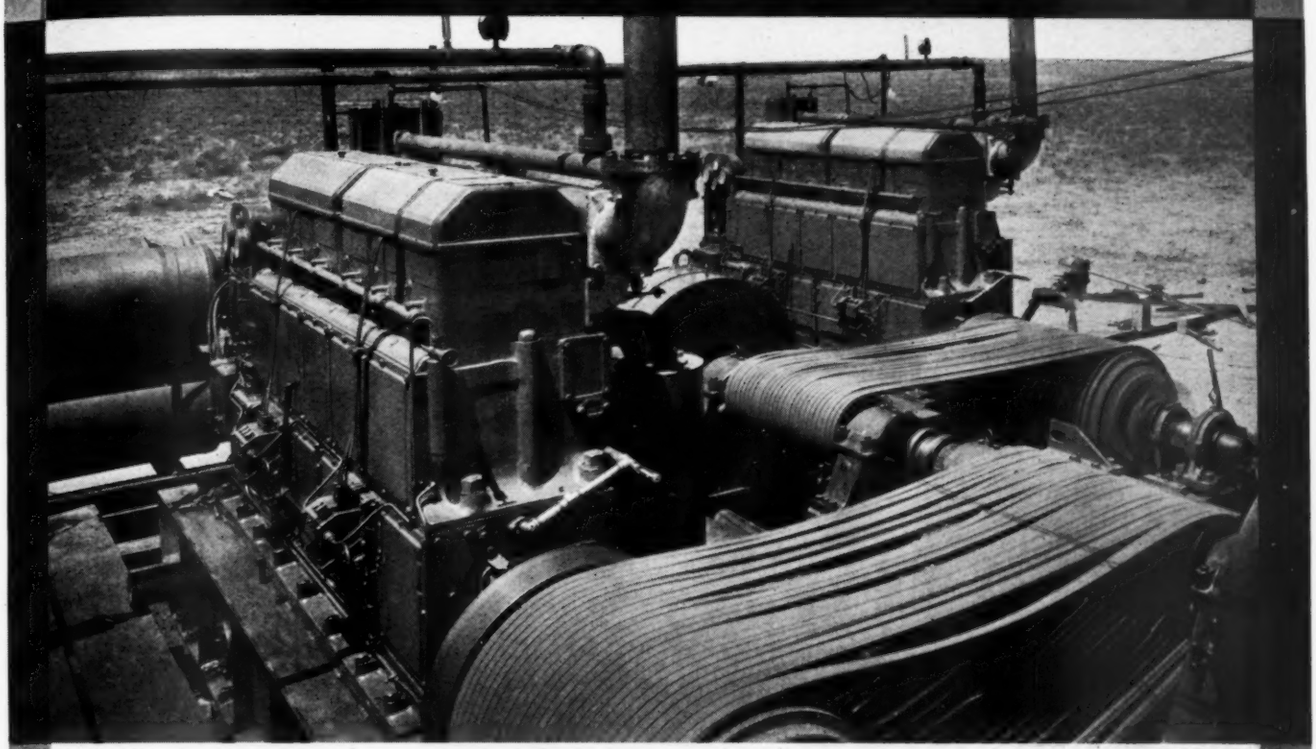

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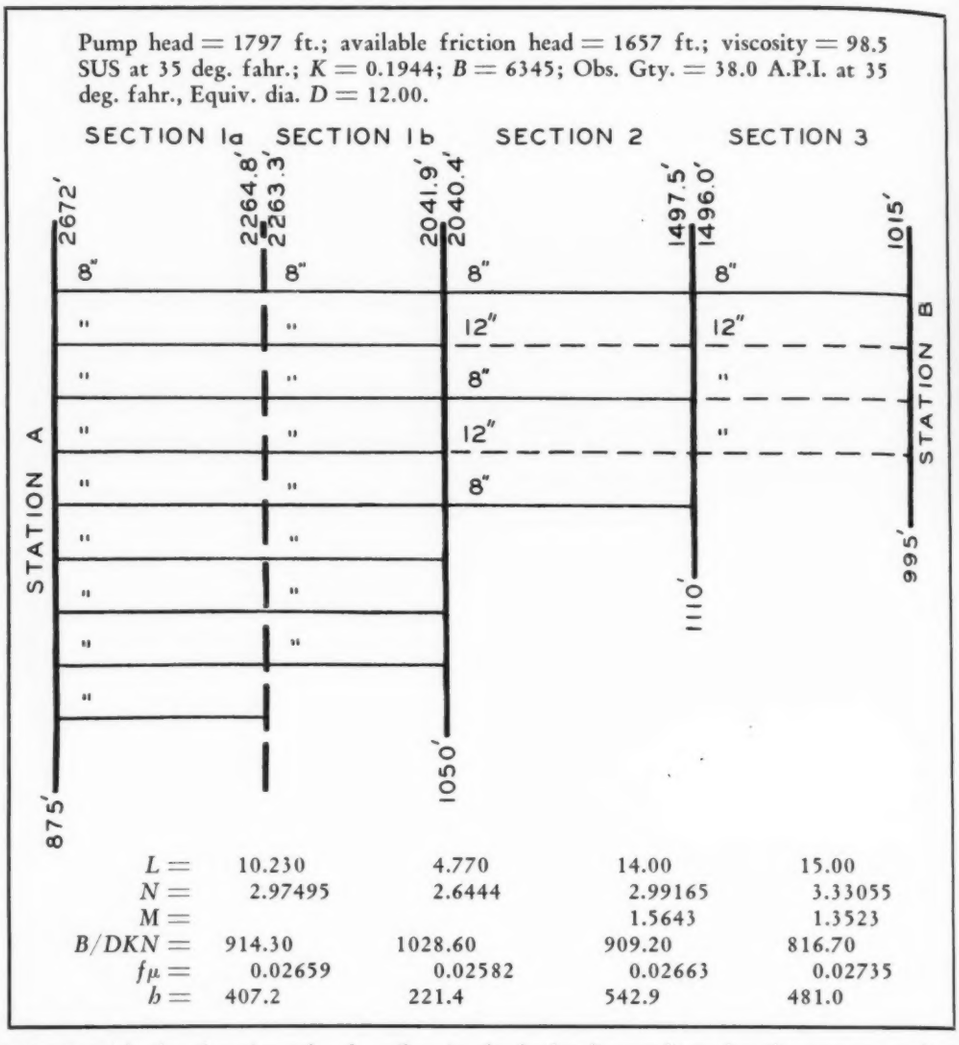

Fig. 3. Diagram of a layout for a trunk line system, showing new loop starting at station "A" and ending somewhere on the section

sufficient size that is connected to all the other lines is installed at both ends.

In Fig. 3 that follows, Fig. 2 has been reproduced to show the new loop starting at station A and ending somewhere on the section. The length of which is the purpose of the following explanation.

By the method outlined above, compute the required new friction head in both section No. 2 and section No. 3, for the same observed gravity and viscosity at 35 deg. fahr. line temperature, using the new value of B of 6345 bbl. per hour. A repetition of the computations necessary will not be given, but the results obtained for the friction head in section No. 2 was 542.9 ft. and in section No. 3 was 481.0 feet.

The next step is to determine the elevation of the hydraulic gradient at the gate plants, particularly the gate plant at the beginning of section No. 2. This is accomplished by starting at station B with the elevation of the hydraulic gradient, which is assumed to be the elevation of the oil in the working tank. Since all stations usually run even with no appreciable flow between the receiving manifold and the working tank to necessitate any friction head allowance, the elevation may be taken as 1015 feet.

Now, going back, or upstream, to the first gate plant, the friction head in section No. 3 was found to be 481.0 ft., and when added to 1015 ft. we find that the elevation of the hydraulic gradient is 1496.0 ft. for the beginning of section No. 3. Since there is a loss of head due to the oil flowing through the gate plant fittings the hydraulic gradient should be offset about 1.5 ft. to the elevation of 1497.5 ft. for the end of section No. 2, in order to represent this loss.

In the next section No. 2, there is a friction head of 542.9 ft. and when added to 1497.5 ft. gives 2040.4 ft. as the elevation of the hydraulic gradient at the beginning of section No. 2. Now add the 1.5 ft. for the gate plant loss and we obtain 2041.9 ft. as the elevation of the hydraulic gradient at the end of the divided section No. 1-b.

The pump head in feet of liquid at station A, for 650 lb. per sq. in., was found to be 1790 ft., and when added to 875 ft., the elevation of the pressure gauge in the discharge manifold, we have 2672 ft. as the elevation of the hydraulic gradient at station A.

The difference between the elevation of the hydraulic gradient at A, of 2672 ft., and the hydraulic gradient at the end of section No. 1-b, of 2041.9 ft., is equal to 630.1 ft., and is the required sum of the two unknown friction heads h_1 and h_2 for sections No. 1-a and 1-b, including the 1.5 ft. offset in the hydraulic gradient for the new gate plant.

In order to compute the actual lengths in miles of both L_1 and L_2, Fig. 4, or we may say, to divide the length $L =$ 15 miles (section No. 1) into the lengths L_1 and L_2 (sections No. 1-a and 1-b), we must first know their corresponding slopes S_1 and S_2 in ft. per actual mile.

From an inspection of Equation 15,

$$h = \frac{5181\, f\mu\, M\, B^2}{2g\, D^5\, N^2}$$

it is seen that this equation can be rearranged to read:

$$h = \frac{5181\, M\, B^2}{2g\, D^5} \times \frac{f\mu}{N^2}$$

and if M is taken as one mile, the slope of the hydraulic gradient in ft. per mile may be computed by the equation

$$S = \frac{5181\, B^2}{2g\, D^5} \times \frac{f\mu}{N^2} \quad \ldots\ldots\ldots \quad (15a)$$

for each of the two new parts of the divided section No. 1, namely, the first part containing the nine lines leaving the station A (section 1-a), and the second part, containing the eight former lines (section 1-b).

The hydraulic slope S_1 for the divided section No. 1-a, containing the nine lines is:

$$S_1 = \frac{5181 \times 6345^2}{64.32 \times 12^5} \times \frac{.02659}{2.97495^2} = 39.15653$$

ft. per actual mile, and the hydraulic slope S_2 for the eight lines or section No. 1-b is:

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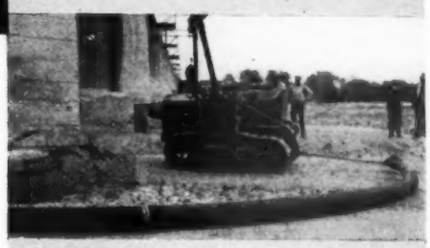

• *A real bend test* was made on this 60 ft. section of Multi-Flame Lindewelded 6-in. pipe. With the section blocked so that the two welds would get the greatest stress, a 60 hp. tractor bent the cold pipe around the concrete column through 180 deg. Neither of the welds cracked, collapsed or buckled.

• *Multi-Flame Lindwelding* was used recently on this 42-mile line of 10-in. diameter pipe. The saving in welding time over older methods amounted to 25 per cent.

• *146 Welds a day* with four men on 12-in. new pipe, 426 welds a day with eight men on 8-in. second-hand pipe, 292 welds with six men on 8-in. second-hand pipe — these are the records made on this pipe line by the use of Multi-Flame Lindewelding.

• *50 Welds a day* per man was the average made by Multi-Flame Lindewelding this 10-in. pipe line.

$$S_2 = \frac{5181 \times 6345^2}{64.32 \times 12^5} \times \frac{.02582}{2.6444^2} = 48.11952$$

ft. per actual mile.

We now have:

$$b_1 + b_2 = (630.1 - 1.5) = 628.6 \text{ ft.}$$
$$S_1 = 39.15653$$
$$S_2 = 48.11952$$
$$(L_1 + L_2) = L = 15.0$$

which are the four required values necessary to compute the two unknown lengths L_1 and L_2 in the original section No. 1. In the solution of this problem it depends entirely upon whether S_1 is greater or less than S_2 as there are two sets of equations for the solution of such a problem.

When S_1 is less than S_2, then:

$$L_2 = \frac{(b_1 + b_2) - S_1 L}{S_2 - S_1} = \frac{628.6 - (39.15653 \times 15)}{48.11952 - 39.15653}$$
$$= 4.602 \text{ miles} \quad \ldots\ldots\ldots \quad (20)$$

and

$$L_1 = L - L_2 = 15 - 4.602 = 10.398 \text{ miles}$$

the required number of miles of new loop to lay for the desired increase in capacity of the station district.

Then for the friction heads, we have:

$$b_2 = L_2 \times S_2 = 4.602 \times 48.11952 = 221.4 \text{ ft.}$$

and

$$b_1 = (b_1 + b_2) - b_2 = 628.6 - 221.4 = 407.2 \text{ ft.}$$

The other set of equations mentioned are also given as they would have been used in this case if the new loop was to have ended at the end of the section No. 1.

When S_1 is greater than S_2:

$$L_1 = \frac{(b_1 + b_2) - S_2 L}{S_1 - S_2} \quad \ldots\ldots\ldots \quad (21)$$

and

$$L_2 = L - L_1$$

Then for the friction heads we have:

$$b_1 = L_1 \times S_1$$

and

$$b_2 = (b_1 + b_2) - b_1$$

There is one important thought the writer would like to make clear, in the event you may have some of your own experimental factors ($f\mu$) together with some you may have collected. That is, to use the exponent $2n + x/n$, which is derived from your friction factors, in the diameter Equation 10.

For instance, plot your experimental values of ($f\mu$) against their corresponding values of the argument B/DKN on logarithmic paper or the log values on regular cross-section paper. Then draw a line averaging all the plotted points for the new values of the friction factors to be used. The slope of this line will represent, as previously explained, the corresponding value of the exponent that must be used in the equation of pipe diameters if all the computations are to have a true mathematical relation.

By adhering strictly to this rule your computations for the several station districts, each of which may be made up of a different pipe layout, will give the same percentage of error, if any, when the actual discharges are known. Otherwise, if the usual method, which is to select the friction factors for the several values of the argument from a table or graph, then use for the exponent $2n + x/n$, either the square root of the fifth power, or some other arbitrary value independent of the value shown by the curve of the friction factors selected, the percentage of error in each station district based on the actual pumping will be different in each station district.

The above demonstrations include all the computations necessary (excepting the Equation of the number of pumping stations and their proper spacing) for the complete solution of all pipe flow problems, and this will conclude what may be termed the application of the Chezy formulae.

A later article will give a discussion and demonstration of the equation of the number of pumping stations and their proper spacing applicable in laying out a new pipe line system.

The next series of articles will deal upon the application of the Hagen formulae in the flow of viscous liquids in pipe lines covering the same problem used in the application of the Chezy formulae.

The primary purpose in the preparation of these articles was to put on paper the results of an extended investigation made over a period of 20 years of practically all the hydraulic literature since Galileo (1595) first turned his attention to a scientific investigation of the flow of water. It was Galileo who after 18 years of investigation spoke to several of his pupils while walking with them along a small ditch of flowing water, those immortal words,

> "I have found less difficulty in the discovery of the motion of the planets, in spite of their amazing distances, than in the investigation of the flow of water which takes place before my very eyes."

What was spoken by Galileo in 1613, nearly three and one-quarter centuries ago, is true today, and apparently we must be satisfied with our empirical formulae until such time that sufficient scientific experiments are made in order that a true law of flow may be discovered.

CORRECTION: On p. 80, August issue, right-hand column, under "Streamline Flow," note the characteristic or index is negative in equation: Log $B/DKN = \bar{2}.6548649 + \log dvy/z$

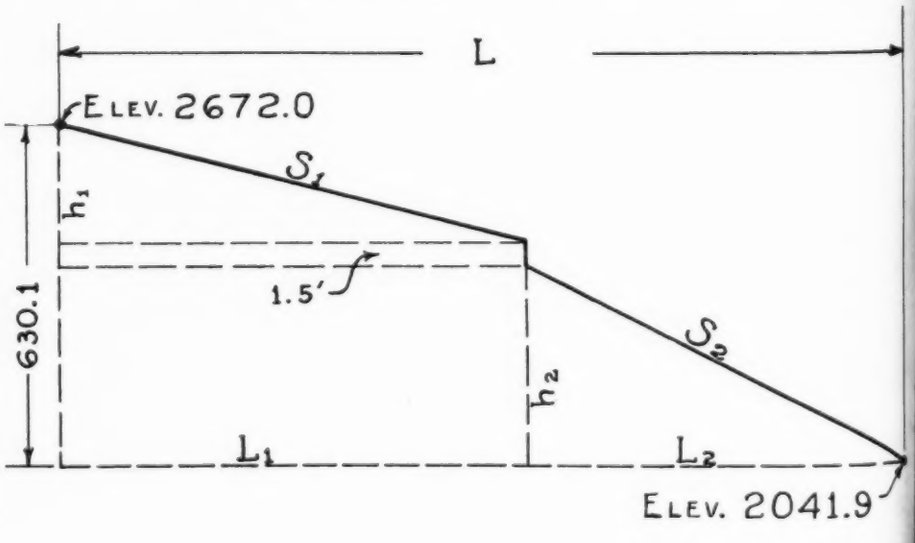

Fig. 4. Diagram showing the lengths L_1 and L_2 to be computed

3 STARS IN THE FISHING FIELD

★

A RECENT FISHING JOB WITH THESE TOOLS

JOB: Fishing for 3½ drill pipe in 6⅝ casing.

DEPTH OF HOLE: Approximately 10,000 ft. with 3½ left hand drill pipe. Top of fish approximately 4000 ft. collar up. FIRST RUN: used SHAFFER EXPANDING PIN TAP WITH SLIPS to catch coupling. Recovered 14 stands leaving plain pipe up. SECOND RUN using SHAFFER-HAMON LEFT HAND SOCKET, backed off and recovered one double, leaving drill pipe collar up. THIRD RUN using PIN TAP backed off and recovered 1½ stands, leaving plain drill pipe up. FOURTH RUN using SHAFFER-HAMON Left Hand SOCKET recovered 28¼ stands, leaving drill pipe up. FIFTH RUN using SHAFFER-HAMON SOCKET recovered one single, leaving plain drill pipe up. SIXTH RUN using SHAFFER-HAMON SOCKET recovered 1¼ stands, leaving drill pipe up. SEVENTH RUN using SHAFFER-HAMON SOCKET recovered 2¾ stands, leaving drill pipe collar up. EIGHTH RUN using SHAFFER PIN TAP with drill pipe collar slips recovered one double, leaving drill pipe collar up. At this time it was decided to attempt jarring out the remainder of fish, using right hand drill pipe. A right hand SHAFFER-HAMON PACKER SOCKET was run. Took hold of fish and jarred two hours without success so released socket and came out of hole. Left hand drill pipe was again run, using a SHAFFER-HAMON Left Hand SOCKET. Took hold of fish and worked for 12 hours trying to back off part of fish without success. The SHAFFER-HAMON SOCKET was then released and after coming out of hole the fish was washed over for 43 ft. NEXT RUN used SHAFFER-HAMON Left Hand SOCKET, took hold, recovered one single, leaving collar up. NEXT RUN the SHAFFER PIN TAP recovered part of fish. In this well 103-lb. mud was being used. Intermittent flowing of well necessitated frequent conditioning of the mud. The job was abnormal in so far that when left handing the back-off normally takes place at the tool joints. The SHAFFER-HAMON PACKER SOCKET held 2000 lbs. pressure and the jarring was done under 1500 lbs. pressure.

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Elements of Applied Petroleum Refining

By W. L. NELSON
Consultant*

CRACKING

Article XXV

THE decomposition of high-boiling petroleum oils into low-boiling oils such as gasoline, by cracking, is of tremendous commercial importance but we have been unable to study cracking in a complete manner because of the complex composition of petroleum oil and the complexity of the products that are produced; however, the major change that occurs during cracking is the decomposition of large molecules into small molecules. In addition to decomposition, some reactive molecules combine with others to give larger molecules than those originally present and such a phenomenon is referred to as polymerization. The decomposition reactions produce pressure distillate or raw cracked gasoline, and the polymerization reactions result in cracked tar or coke. The cracked gas that is always produced during cracking is produced as a result of decomposition and it cannot be avoided because some of the molecules are cracked too severely while the others are being decomposed into gasoline.

Factors That Affect Cracking

The rate at which cracking occurs is governed mainly by three factors, namely, the time at an elevated temperature, the temperature that is employed, and the character of the cracking stock. If a material is held at a temperature exceeding about 700 deg. fahr., products are collected continuously and at an even rate until a yield of about 20 percent of raw gasoline is produced. After 20 percent has been produced, the yield of product during a given length of time decreases and finally no more material is produced unless the temperature or pressure is changed. Up to a yield of 20 percent the main reactions are decomposition reactions but as the yield is further increased, the combination or polymerization reactions begin to be effective and the products of decomposition combine with one another to some extent to give high-boiling tar-like materials.

The high yields (often more than 60 percent) that are produced in commercial operations are obtained by recycling. In this operation the feed stock is decomposed to the extent of about 20 percent and it is then fractionated to separate the 20 percent of raw gasoline, a small amount of gas, about 12 percent of tar, and about 65 percent of so-called recycle stock. The recycle stock is then mixed with fresh charge to make a total of 100 percent and the mixed feed constitutes the charge to the cracking still. The whole operation is conducted continuously so that about three or four times as much stock is charged to the cracking still each day, as the amount of new or virgin stock that is the true feed stock for the entire cracking system. If more than about 20 percent is produced in a single pass or cycle through the still, coke will be deposited on the heating surfaces and the operation is not so economical as it should be, although the gasoline will have a higher octane-number.

The effect of *temperature* is very great, not so much because of differences in the properties of the gasoline that is produced, but because the rate of cracking is much greater at a high temperature. The rate of gasoline formation doubles for every increase of temperature of about 22 deg. fahrenheit. Thus, if the rate is 20 percent in 2400 seconds at 800 deg. fahr., the time required for a 20 percent yield at 822 deg. fahr., will be only 1200 seconds and at 900 deg. fahr., only about 100 seconds. A short time such as 100 or 200 seconds is an advantage because a large storage space for the hot oil as it undergoes decomposition is not necessary. In other words, the cracking can be conducted in the tubes of a pipestill rather than in a chamber. Fig. 49 indicates the rate of cracking at several cracking temperatures. The effect of temperature may be formulated as follows:

For a constant yield of material:

$$V_2 = \frac{V_1}{2^{\left(\frac{T_2 - T_1}{x}\right)}}$$

V_2 = Time to produce a given yield at temperature T_2

V_1 = Time to produce a given yield at temperature T_1

x = Number of degrees required to double the yield (about 22 for mixed-phase processes and about 45 for vapor-phase).

For a constant length of time:

$$C_2 = C_1 \times 2^{\left(\frac{T_2 - T_1}{x}\right)}$$

EXAMPLE 38. Effect of Temperature on Rate of Cracking.

A still operating at 900 deg. fahr., produces a yield of 17.3 percent of gasoline.

1. If the temperature is raised to 905 deg. fahr., but the time remains the same, what will be the approximate yield?

$$C_2 = 17.3 \times 2^{\left(\frac{905-900}{22}\right)} = 17.3 \times 2^{.2275}$$
$$= 17.3 \times 1.171 = 20.3 \text{ percent.}$$

The result can be checked approximately by Fig. 49.

2. By reference to Fig. 49 how long a time in the still is indicated?

Read upward from 17.3 percent to the 900-deg. fahr. line and the time is approximately 97 seconds.

3. What length of time would be required if the still is to be operated at 905 deg. fahr., but to produce only 17.3 percent?

$$V_2 = \frac{97}{2^{\left(\frac{905-900}{22}\right)}} = \frac{97}{1.171} = 82.7 \text{ seconds.}$$

The fact that the yield changes greatly with temperature is very helpful in the operation and design of cracking plants. Thus, if the crack-per-pass is too low and recycle stock accumulates, the plant may be balanced by changing the temperature only a few degrees.

The yield that may be expected is greatly dependent on the properties of the charging stock, particularly the gravity. However, the yield is also dependent on the degree of cracking that is practiced, that is, whether a high gravity tar or a low gravity tar is produced. Obviously the greatest yield can be produced if the residue is coke. The yields that may be expected when cracking to different extents are indicated in Table 38.

The determination of yields has been more thoroughly dis-

*Professor of Petroleum Refining, University of Tulsa.

TABLE 38
Yields by Cracking

Charge Stock		Yield of 400 E.P. Gasoline when running to:		
Name	A.P.I	15 A.P.I. Fuel Oil	8 A.P.I. Fuel Oil	Coke
Naphtha	45	70	80.	----
Distillate	35	55	65.	83
Gas Oil	25	40	51.	76
Fuel Oil	15	----	29.	41

cussed in *The Petroleum Engineer* for August, 1933.

The different stocks appear to crack at about the same rate except that very light stocks such as distillate or naphtha, and stocks that have already been cracked, require a longer time. Such materials are referred to as refractory stocks. As an example, recycle stock cracks at only half the rate that a normal stock cracks.

Properties of Cracked Materials

The hydrocarbons composing cracked materials are quite different from those in ordinary petroleum products. No complete analyses have been made because of the complexity of the materials but it appears that naphthenic, aromatic, and unsaturated compounds are present in much larger quantities than in straight-run products.

For a given boiling-range, the gravity of a cracked product is always much lower and the viscosity is lower. Thus, 400 E.P. straight-run gasoline has a gravity of about 61 whereas cracked gasoline has a gravity of about 57. As a further example, the viscosity of a straight-run tar that starts to boil at 1000 deg. fahr., may have a viscosity of 140 seconds at 210 deg. fahr., but a similar cracked tar may have a viscosity of only 80 seconds; however, these properties vary through a great range, depending upon the extent of the cracking operation. Recycle stock that has about the same boiling-range as gas oil may have a gravity of 17 A.P.I.

The octane-number of straight-run gasolines normally ranges from 40 to 50, whereas cracked gasolines have octane-numbers ranging from 70 to 80, and cracked gasoline from vapor-phase processes may have an octane number of 100.

Cracking Systems

The processes for the decomposition of oil for the production of gasoline may be classified as follows:

1. *Liquid-Phase.* Very few processes in which a true liquid-phase exists, have been used. Perhaps the most notable is the Burton Process.
2. *Mixed-Phase.* Most of the familiar processes, such as the Dubbs, Cross, Holmes Manley, Tube and Tank, and Tubestill, are usually classed as mixed-phase processes.
3. *Vapor-Phase.* In these processes the temperature is so high that the stock is vaporized and the main decomposition occurs while the stock is in the form of a vapor. The Gyro and de Florez processes are examples.
4. *Viscosity-Breaking.* In these processes only a small amount of decomposition is practiced. Very little gasoline is produced but the viscosity and pour-point of the stock are lowered.
5. *Reforming.* These processes may be mixed or vapor-phase processes but they are operated on naphtha or kerosene as a charging stock to produce a large yield of anti-knock gasoline.
6. *Coking.* To produce coke by cracking it is only necessary to allow a longer time and to provide drums or chambers in which the coke may be deposited.

The theory underlying these different groups of processes is much the same in all, but the operating conditions such as the temperature, pressure, and time, are changed in order to get the desired results. The effect of temperature and time have already been discussed but pressure was not mentioned. The main effect of pressure is a physical one. If the pressure is high, vaporization is suppressed and the decomposition may take place in the liquid-phase or in a phase condition that is largely liquid. If the pressure is low, vapor is formed and the process may become a vapor-phase process. Furthermore, refractory stocks, such as naphtha, require more time and hence it is usually advisable to use a high temperature and a high pressure in order to accomplish the cracking in a reasonable length of time. The conditions at which these processes are conducted are indicated in Table 39.

QUESTIONS

1. What two types of reactions or changes take place during cracking?
2. List the three factors that have the greatest influence on cracking?
3. If 20 percent of gasoline is produced at 922 deg. fahr., how much gasoline will be produced in the same length of time at 900 deg. fahr. *Ans.*—10 percent.
4. What two factors govern, to a large extent, the ultimate yield of gasoline?
5. What is meant by "refractory stocks"?
6. Explain the difference between mixed-phase and vapor-phase processes?

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4. Nelson—"Cracking," *The Petroleum Engineer*, July, August, and October, 1933.
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TABLE 39
Approximate Operating Conditions

Kind of Cracking	Temperature deg. fahr.	Pressure
Mixed-Phase	860-940	300-600
Vapor-Phase	1050-1200	35-100
Reforming	970-1020	300-800
Viscosity Breaking	840-870	100-300

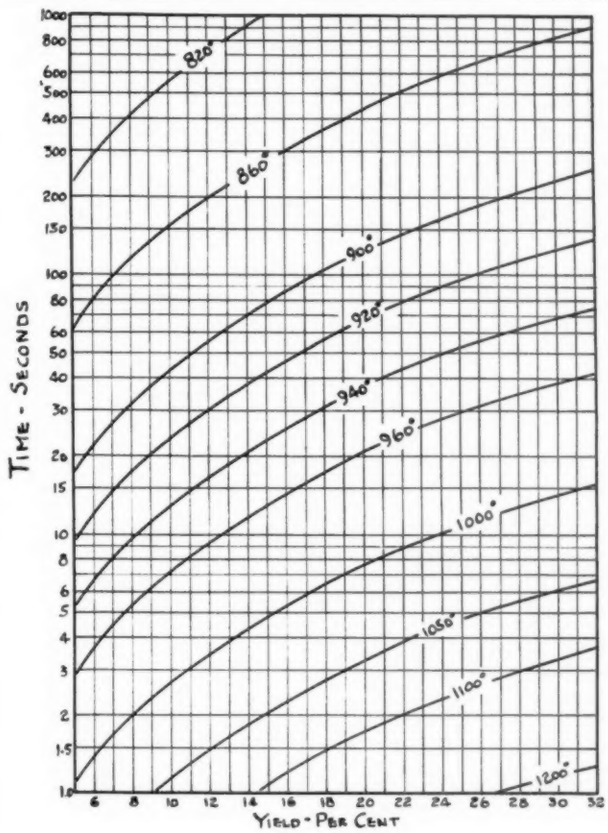


Fig. 49. Effect of temperature and time on yield by cracking

WHEN YOU SHARPEN YOUR PENCIL

and get down to facts

THERE are three points to be sure about when you select equipment for guiding, floating and cementing strings of casing.

But you should be very sure that these features are present—in proper balance and always in combination, to insure 3-point landings—Happy Landings—of *your* casing.

1 - STRENGTH

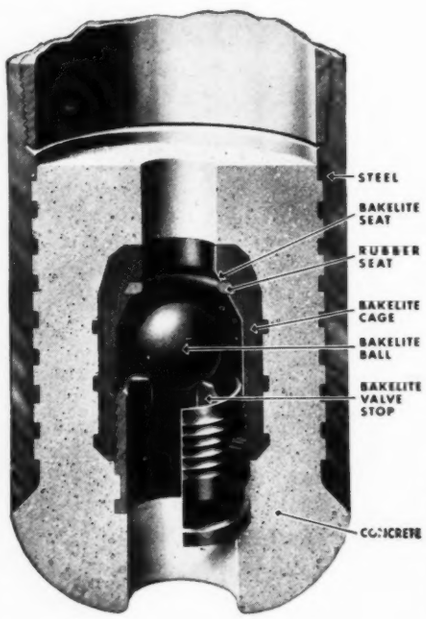
beyond the collapsing strength of your casing—always present in Baker Cement Equipment.

2 - VALVE EFFICIENCY

as provided by the streamlined passages for cement through the bakelite valve cage, and the unequalled efficiency of the floating bakelite ball which forms a leak-proof double-seal against rubber backed by bakelite the instant any back pressure develops.

3 - DRILLABILITY

which only Baker provides with an internal plug and valve made of special formula concrete, and bakelite set vertically to present a small cross-section to the drilling bit. Both bakelite and concrete are drilled up easily and rapidly into small fragments which circulate out of the well, leaving the hole free from metal or other objectionable material and ready for immediate coring or safe, straight-hole drilling.



This cutaway of a Baker Cement Float Shoe illustrates the three-point internal construction, but we refer you to pages 138 to 146 of the 1935 Composite Catalog for complete details and specifications.

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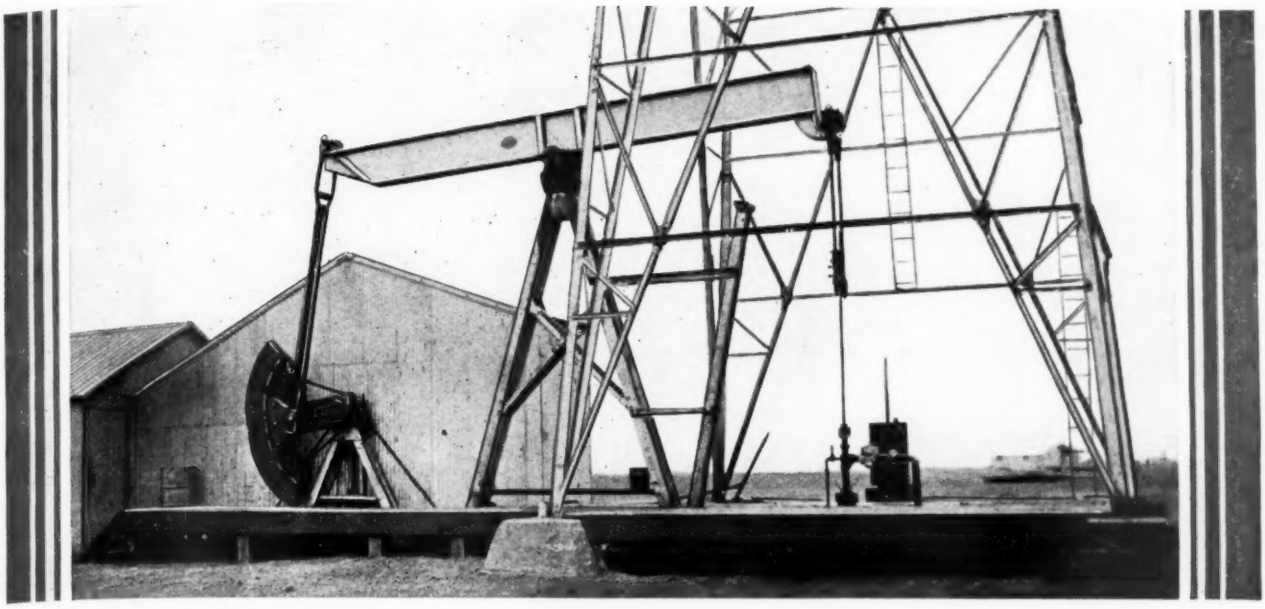

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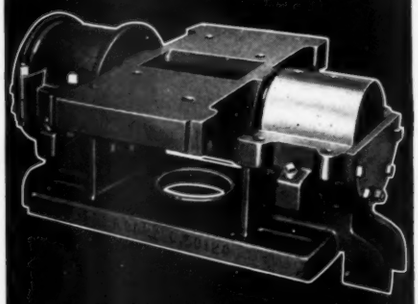
Heavy Pumping Wells



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Parkersburg Flood-Lubricated Center Bearings have a patented adjustment feature, permitting both a lateral and longitudinal movement of the Walking Beam to compensate for misalignment of the Sampson Post with the well center.

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All bearings are enclosed, flood-lubricated, dust and oil tight. They provide positive lubrication, have over-size bearing areas and ample reserve oil capacity . . . assuring years of trouble-free service. Provision is also made for lateral adjustment of the Saddle Bearing to compensate for misalignments. Pitmans can be supplied with babbitted or roller bearings.

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Controlled Directional Well-D

By JAS. D. HUGHES

THERE are numerous deflecting tools that are used in directional work, and a number of special bits. The geological and mechanical conditions should in all cases determine the choice of the tools and bits used. The principal deflecting tools with which the writer has come in contact are:

1. Removable whipstocks
   (a) Regular type (soft digging), Fig. 15
   (b) Oklahoma type (rock-bit digging), Fig. 16
   (c) 35-type (enclosed-circulating), Fig. 17
2. Knuckle-joints
   (a) Harcus-Scott hole-straightening bit, Fig. 18
   (b) Harcus-Scott knuckle-joint, Fig. 19
   (c) Lewis knuckle-joint, Fig. 20
   (d) Plain universal or knuckle
3. Eastman spinning spudder, Fig. 21
4. Eastman-Brewster
5. Hydraulicking bit, Fig. 22
6. Casing whipstock
   (a) Automatic
   (b) Plain.

Because of its simplicity and consistency of results the removable whipstock is the most generally used deflecting tool. It consists (Fig. 15) of one chrome nickel-steel casting of a chisel point to engage the bottom of the hole and prevent turning, a tapered concavity to guide the whipstock bit into the wall of the hole, and a stout ring or collar on top by means of which the tool is withdrawn from the hole. The whipstocks can be cast with one of three types of footpiece: chisel, rotary shoe, and "T" three-point, thus permitting a selection capable of giving the best bottom engagement for the type formation in which the tool is to be set. In shales and on cement the chisel bottom is most frequently used. In salt, lime, and other rock-bit formations the rotary shoe or "T" three-point bottom is used.

The size of the whipstock is based on the O.D. and ranges from 5½ to 10 inches. Accompanying is a table giving the general dimensions.

In the Oklahoma fields it was necessary to develop a special whipstock in order that circulation could be established from the bottom and by this means washed to the bottom of the hole. This was done by making an enclosed water course within the body of the whipstock terminating on bottom in the center of the foot piece and on top at a hole on the concave side about two ft. below the ring. A special rock-bit hook-up is used (Figs. 16 and 16-A) in which all but one water course is greatly reduced. A short length of copper tubing connects this one full-sized water course with the circulation hole in the face of the whipstock. The tubing is milled up after the whipstock is landed.

For sidetracking in soft formations a special bit is used in conjunction with the whipstock (Figs. 15 and 15-A). This bit is equipped with spirals designed to hold the cutting edges away from the concavity and to shoulder the bit into the whipstock ring, which, being smaller than the bit, allows the whipstock to be lifted with the bit.

In hard formations a rock bit is substituted, being of a size sufficiently larger than the whipstock ring that it also lifts the whipstock.

Whichever bit is being used is shouldered in the whipstock ring and secured there by a threaded shear pin that screws through a bushing in the ring into the shank of the bit. This fixes the whipstock rigid with respect to the drill pipe and thus turns with the pipe as it is oriented into the hole as previously described. Upon reaching bottom the pipe is raised and lowered several times to work out the torque and then set down. The weight applied to shear the pin jams the whipstock point into the formation, or top of the cement plug, and frees the bit.

By rotating slowly down the face of the whipstock with no weight, the bit works on the wall without binding against the whipstock and imparting a turning moment. By the time the bit is down

Fig. 15 (Left)—Regular type removable whipstock for soft digging

Fig. 15-A (Below)—Special bit used in conjunction with whipstock shown in Fig. 15

Fig. 16 (Right)—Oklahoma type removable whipstock (for rock-bit digging)

Fig. 16-A (Below)—Special bit for use with whipstock shown in Fig. 16

Drilling and Surveying Practice

Part IV

to the base of the whipstock (maximum section) it is almost entirely out in formation. Using a double of small-diameter drill pipe with the bit to gain flexibility, when this point on the whipstock is reached, the application of three or four points of weight will cause the pipe to bow in to the whipstock and fulcrum upon the base, permitting the bit to continue at the angle imparted by the whipstock.

Normally, three round trips are required to complete a whipstocking operation, namely:

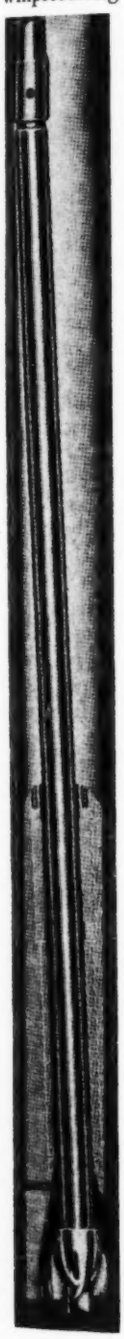


Fig. 17. 35-type removable whipstock (enclosed circulating)

1. Orientation and drilling off, in which approximately 15 ft. of rat hole is made below whipstock. See Figs. 23, 24, and 25.

2. Follow-up run of 25 or 30 ft., with special bit on same limber pipe set up to augment angle gained from whipstock.

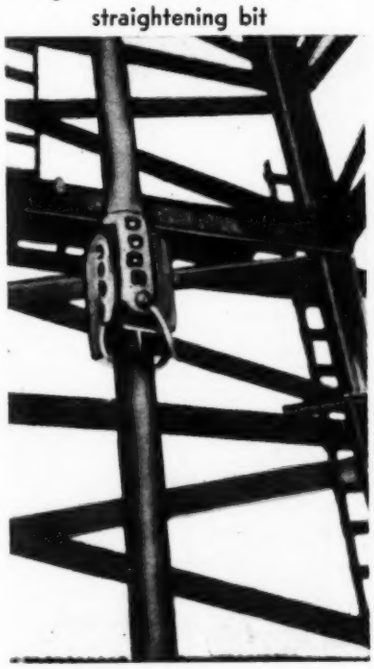
3. Reaming of rat hole to gauge with special pilot reaming bit.

With plain drill pipe the amount of sidetrack hole that can be made below the whipstock depends upon the length of the bottom joint that can work through the whipstock ring without engaging the tool joint. On directional jobs where there is a likelihood of a number of whipstocks being set, it has been found practical to use a double of external flush-joint drill pipe with the whipstock and thus eliminate the follow-up trip. This not only reduces sidetrack drilling time by one-third but in many cases actually builds up angle faster by virtue of the whipstock remaining in the hole to act as a guide.

The type-35 whipstock is essentially a cylindrical casting with the inner core at an angle. Three sections of hard rubber rings are secured within, through which the external flush-joint drill pipe works, excellently lubricated by the mud. In practice the pipe is threaded through the whipstock and a special bit made up that shoulders into the bottom of the whipstock and is secured by means of a threaded shear-pin. As in the other type whipstocks, the bit is larger than the shouldering ring and thus enables the tool to be withdrawn with the bit.

Advantages of this type whipstock are its ability to wash easily to bottom; the action of the bit immediately on the bottom of the hole; less abrupt deflection and minimum "sticking" hazards. At present only one size, 7⅝-in., is available.

Fig. 18. Harcus-Scott hole-straightening bit



To the writer's knowledge the first adoption of the universal joint in a drilling string was made in the Chauk field of Burmah in the spring of 1930. Messrs. Harcus and Scott[20] designed the tool in 17-in. and 15¾-in. sizes with reamer section and various lengths of drill pipe below the universal (Fig. 18). The tool was called the Harcus-Scott hole-straightening bit and was successfully run in the field mentioned. It was later successfully used as a deflecting tool in directional drilling problems.

The knuckle joint shown in Fig. 20 has many features similar to the Harcus-Scott tool, the chief difference being in the exposed spring arrangement used in the latter to establish orientation. The length of pipe below the universal and reamer section and referred to as the "stinger" is equipped with either a diamond point or rotary shoe bit. Circulation is carried to the bit through the universal and for this reason makes a good tool in holes having strong bridging proclivities.

In those cases where it is desired to sidetrack a plug without regard for direction the writer has frequently used the following arrangement: A Baash-Ross universal is made up on a short length of small-diameter hydraulic tubing to the lower end of which is fitted a bit considerably smaller than the gauge of the hole. Before touching bottom the pumps are opened up and upon touching bottom considerable weight is applied, which will cause the string to angle at the universal and lie against the wall. The stinger is then pointing in the opposite direction and rotation begun. By "crowding" on the weight sidetracking is practically assured.

The spinning spudder,

[20]Personal communication.

(Continued on Page 98)

Fig. 19. Harcus-Scott knuckle-joint

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The Waukesha-Hesselman is in no sense a semi-Diesel. No preliminary warming-up of hot bulbs or hot spots. It starts as easily, burns its fuel as cleanly, runs as smoothly as a gasoline engine . . . develops equal or greater power, and is moderate in first cost.

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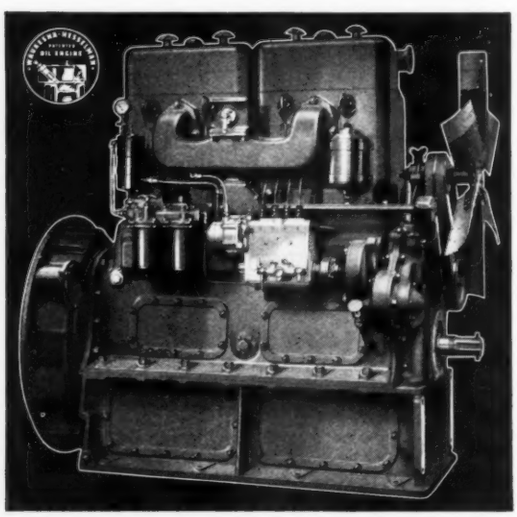
It is recommended for industrial tractors, electric lighting and power plants, road building, logging, oil field and contractors' machinery, marine propulsion, etc. *Write* for Bulletin 1000. *Waukesha Motor Company, Waukesha, Wisconsin.*



WAUKESHA ENGINES

THIS IS NO. 6 OF A SERIES on the Hesselman Oil Engine. A reprint of the complete series will be mailed on request.

Institute Finds Petroleum Industry's 1935 Statistical Position to Be Satisfactory

Evidence that the petroleum industry is operating along conservative lines while facing virtually unprecedented increases in demand for certain products is presented by the American Petroleum Institute in a review of the industry's statistical position as of August 15. The review is being published in booklet form by the trade association for distribution throughout the industry.

Sales of gasoline were reported to be running above expectations, with indications that total domestic demand for 1935 would establish an all-time record. During the first half of 1935 domestic demand increased 3.4 percent, and total demand, which includes exports, increased three percent over the first half of 1934.

Gasoline exports were revealed as close to the 1934 level and showing no large reduction for the first time since 1931. Also, for the first time since 1931, seasonal demand for gasoline reached its full trend. There were indications that total demand for 1935 would be more than four percent above that of 1934, but warning was sounded that despite gains in sales of motor cars and trucks gasoline consumption in the last quarter of 1935 might fall below the abnormally high level reached in the last quarter of 1934.

Stocks of gasoline on July 31 were found to be approximately 1,700,000 bbl. less than on the corresponding date of 1934, with economic working stocks of 51,110,000 bbl. in storage on September 30 next possible of realization. California's reduction of 3,700,000 bbl. in stocks was said to have contributed substantially to the improved storage situation. The figures indicated that some refinery districts may experience difficulty in reducing stocks to economic levels on September 30. In this regard, it was explained that experience indicates the industry closely should watch its operations in relation to the decline in seasonal demand if it desires to avoid an uneconomically high inventory position as of March 31, 1936.

Runs to stills, reflecting refinery operations, during July appeared to have been approximately 70,000 bbl. daily higher than economically necessary, or about three percent.

Continuous improvement was found in regard to stocks of crude oil, with the estimated 330,730,000 bbl. in storage on July 20, representing the lowest recent level of above-ground stocks since 1926. Withdrawals of crude oil from stock up to July 20 were reported to average 17,000 bbl. daily below those of 1934. Indications were that the supposed surplus of crude oil immediately available for refining is smaller than generally is supposed.

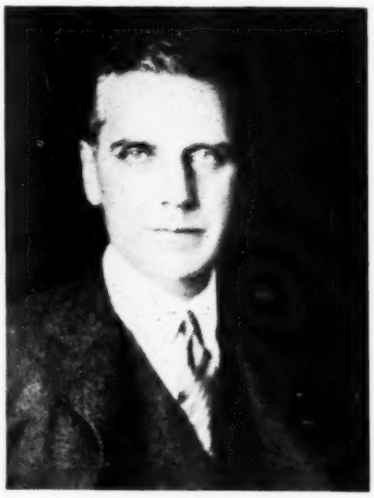
Drilling activity during the first half of 1935 was found to be 20 percent more than during the first half of 1934. Increases were noted chiefly in states where wells have largest initial production—Texas, California, Oklahoma, and New Mexico. The report stated that so far this year there have been discovered new crude oil reserves somewhat greater than estimated crude oil requirements for the entire year.

During July reported crude oil production was approximately 70,000 bbl. per day higher than necessary economic requirements. To the extent that crude oil was produced illegally and unreported, the excess production was correspondingly higher. During the week ended August 3, however, an improvement in this connection was shown. As of this date, daily production requirements for the remainder of the year appear as follows: September, 2,606,000; October, 2,550,000; November, 2,552,000, and December, 2,550,000. Coöperation on the part of state governmental agencies and oil producers in important oil-producing states was said to be contributing to the stability of this branch of the industry.

While a decline of 6,000,000 bbl. was found in gas and

John Primrose Made Vice-Chairman of Board of Foster Wheeler Corporation

John Primrose, who has been vice-president of the Foster Wheeler Corporation since it was organized, has been elected to the office of vice-chairman of the board, following the resignation of Pell W. Foster, who will continue as a director.



JOHN PRIMROSE

In 1901 Mr. Primrose became chief engineer of the Power Specialty Company and subsequently vice-president in charge of oil refinery activities. When the Foster Wheeler Corporation was formed, he was elected a vice-president, which office he has held to the present time. Through these associations he has become well known in the oil refining industry in this country and abroad.

Exports Petroleum Products From U.S.S.R.

The exports of almost all petroleum products from the U.S.S.R., except special oils, increased from 1929 to 1932, but with the exception of lubricating oils decreased in 1933 and 1934. The greatest decrease was in exports of gasoline, which in 1934 were little more than half the quantity exported in 1932. Fuel oil comprises the greatest percentage of the Soviet exports of mineral oils followed by gasoline.

New B & W Sales Office

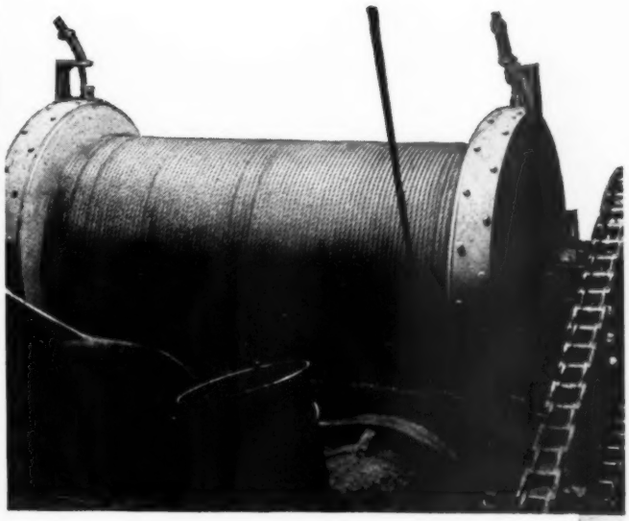
The Babcock & Wilcox Company announces the opening of a sales office at 1809 Railway Exchange Building, St. Louis, Missouri.

F. C. Brandt, formerly of the Chicago office of this company, is in charge of the new office, which will serve the eastern half of Missouri and the southern section of Illinois.

Struthers-Wells Company Opens Cleveland Office

The Struthers-Wells Company of Warren, Pennsylvania, announces they are now represented in the Cleveland, Ohio, district. The office is in the Union Building, 1838 Euclid Avenue. B. W. Rogers and P. M. Kline are in charge.

fuel oil in storage as of June 30, when compared with a year ago, the report said the industry might experience a 1935 demand at only about the 1934 level, and might expect overproduction and overstocking in some areas because unexpectedly high levels of gasoline demand have caused relatively high rates of crude runs to stills and, therefore, higher fuel oil production. Distillate fuel consumption was reported as showing satisfactory gains. Substantial increases in sales of domestic and industrial oil burners during the first half of 1935 were taken to indicate that the additional inventories east of California possibly may not prove too burdensome.



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TRU·LAY *Preformed* ROTARY LINES

Fig. 22. Hydraulicking bit

(Continued from Page 95)

now under construction, consists of a 2½-deg. elbow below which is carried a device similar in many respects to an automatic screw driver. The tool is oriented to bottom, the drive bushings placed around the Kelly and the table locked against rotation. As the pipe is lowered the driver in the tool causes the bit to revolve 2½ times. With pumps running, the pipe is raised and lowered, the bit turning and digging at each lowering in the direction in which the elbow was faced.

Good results have been obtained in California with a similar but cruder tool made from a section of square Kelly, which had been given a quarter twist, and which had an internally square driver free to slide up and down around the Kelly. Above the rider and Kelly section was a machined angle sub, which allowed the device to be oriented.[21]

Another tool now undergoing field tests and development is the Eastman-Brewster angle joint. The tool, briefly described,

[21]Personal communication.

Fig. 20. Lewis knuckle-joint

Fig. 21. Eastman spinning spudder

Fig. 23. Showing bit drilling below whipstock

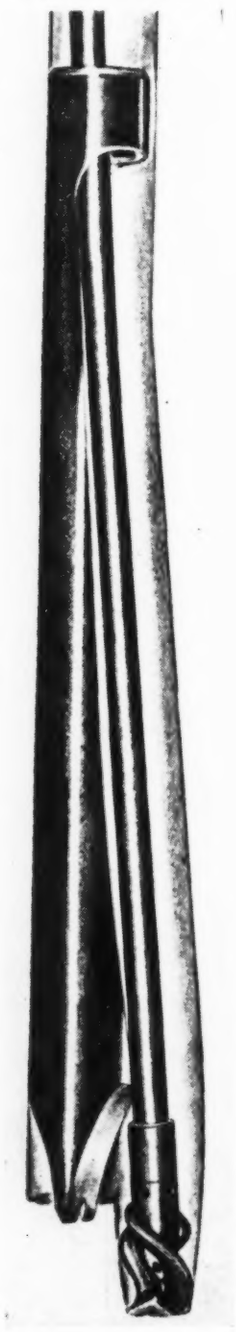
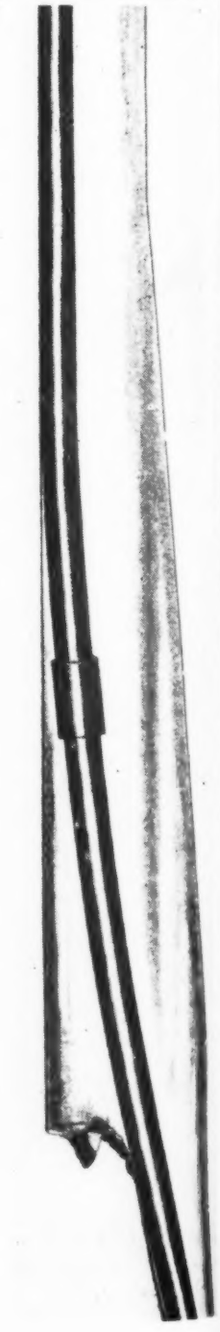


Fig. 24. Showing bit engaging ring preparatory to lifting whipstock

Fig. 25. Showing action of limber drill pipe in follow-up run. Shoulder is reduced in pilot reamer run



consists of an outer casing bent to an angle of 2½ degrees. Carried within the outer casing and mounted on roller bearings are two straight sections of small drill pipe, the union of the two being effected at the angle by an ingenious universal; the entire inside mechanism runs in an oil bath. On the front and back sides of the outer casings are ribbed sections, or sled runners. Another knife edge at the top is freed by a shear-bolt when the tool is set and expands into the wall. In this manner the device is oriented into the hole and sheared, the knife edge and sled runners hold the outer casing fixed in the hole while the inside is free to rotate. About six ft. of hole made in this fashion is sufficient to establish the deflection. A follow-up bit is then run to build up from this initial deflection.

The hydraulicking spudding bit shown in Fig. 22 is used only in extremely soft formations where it is impossible to deflect with any of the other devices mentioned. The bit is oriented to bottom, torque removed from the pipe, drive bushings set, and the rotary table locked. The bit is then set down on bottom and the pumps started. The jetting action upon the curved upper face of the bit attacks the side of the hole; the bottom, being spoon-shaped, allows the bit to slide off in the direction of the washing action. Two wheels set in the back side aid the bit in its sliding. The bit is spudded occasionally during the operation. Usually three or four ft. of hole made in this manner is sufficient to gain the required initial deflection.

Very often a directional drilling job is begun by deflecting initially through casing. In this connection a casing whipstock can be considered as a deflecting tool.

This type of whipstock is generally understood and the writer classifies them as automatic and plain or old-fashioned.

Under automatic falls the Kinzbach, which automatically sets the whipstock between couplings by means of a trigger releasing spring-actuated slips. The Eastman casing whipstock also finds the couplings and sets hydraulically, it will not set prematurely but can be moved freely up and down the hole until the pumps are applied.

Another whipstock known as the Turner turnless is semi-automatic in that it must be set either on the collar-finding plug or on a previously set cement plug.

The plain whipstock is either a tapered section of hard casing or a tapered forging, to the bottom end of which an anchor of pipe is secured. The anchor is set in cement to hold the whipstock in place. Any of the above-listed whipstocks can be oriented and set to mill out in the desired direction.

TABLE SHOWING GENERAL DIMENSIONS OF WHIPSTOCKS

Size		Ring I.D.	Ring Length	Whipstock Length	Concave Length	Degree Dog-leg	Bit Size	Pipe Size
Nominal	O.D.							
5-in.	5½-in.	3	6	115¼-in.	99½-in.	2° 45′	4⅝-in.	2½
6½-in.	6¼-in.	4¾	7	121 -in.	93 -in.	3° 09′	5⅝-in.	3½
7½-in.	7½-in.	4¾	8½	129 -in.	96 -in.	3° 26′	5⅝-in.	3½
8½-in.	8⅝-in.	6¼	8½	132 -in.	96 -in.	4° 15′	7¼-in.	4½
10 -in.	9⅞-in.	7¼	9	143 -in.	105 -in.	4° 21′	8⅝-in.	4½

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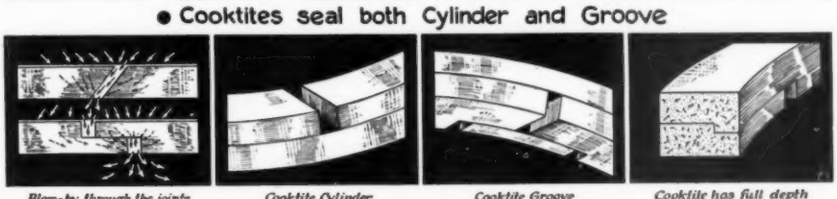

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Alvin B. Calkins Visits California

Alvin B. Calkins of the Bettis Sales Company, representatives for the Regan Forge and Engineering Company in the Mid-Continent, has just returned from an extended visit to California. Calkins spent several weeks inspecting Regan equipment in the California fields and in the study of new Regan products soon to be announced.

R. E. Rogers, Jr., Rejoins Foxboro

Having returned to the United States after a sojourn of a year and a half as instrument and process engineer for refineries in the Netherlands West Indies, Robert E. Rogers, Jr., has rejoined the engineering-sales staff of the New York office of The Foxboro Company, Foxboro, Massachusetts. Rogers first became identified with The Foxboro Company in 1930, and was connected with the Tulsa and New York offices, serving Mid-Continent and Eastern process industries, before leaving for the Indies early in 1934.

Increase in Japan's Crude Production

There was a very substantial increase in production of crude oil during 1934 in Japan, due primarily to larger output in the Akita districts of Japan Proper. The total for Japan Proper for the year is given as 1,799,458 bbls., compared with 1,419,544 bbls. for 1933, the increase amounting to approximately 27 percent. Production in Taiwan in 1934 declined to 35,098 bbls. from 36,475 bbls. for 1933. The combined total for the Empire for 1934, therefore, was 1,834,556 bbls., a gain of 26 percent compared with 1933.

Production of natural gas in Japan Proper and Taiwan during 1933 amounted to 4,087,180,000 cu. ft., an increase of about 9 percent compared with 1932. Details for 1934 are not available but it is believed that there was a slight increase over the previous year due primarily to the opening up of new wells at Kinsui in Taiwan.

Imports of crude oil in 1934 amounted to 7,675,677 bbl. against 6,448,938 bbl. for the previous year, an increase of 19 per cent. In both cases direct imports by the Japanese Government are excluded.

Midwest Regional Meeting American Chemical Society

The thirteenth Midwest Regional Meeting of the American Chemical Society was held at the Brown Hotel, Louisville, Kentucky, October 31 to November 2, inclusive.

The Division of Petroleum Chemistry held its meeting October 31. Dr. Gustav Egloff is chairman of the Division of Petroleum Chemistry and Clarke C. Miller, of the Standard Oil Company, Wood River, Illinois, is acting as vice-chairman.

The Petroleum Division program was as follows:

"Effect of Crude Source on Diesel Fuel Quality," by W. H. Hubner and G. B. Murphy.

"A Modification of Suspended Level Viscosimeter," by E. H. Payne and C. C. Miller.

"A Study in Sweetening Reagents," by Charles Wirth III and G. B. Murphy.

"Reforming Gasolines of the World," by Gustav Egloff, E. F. Nelson, and G. B. Zimmerman.

"Thermal Stability of Paraffin and Olefin Hydrocarbons," by Gustav Egloff and C. I. Parrish.

"Gasolines and Their Compositions," by J. C. Morrell and Gustav Egloff.

"Antioxidant Process for Refining Motor Benzol," by V. Voorhees.

"High Temperature Expansion of Petroleum Fractions," by K. M. Watson and G. B. Murphy.

Dr. Egloff also gave an address before the entire meeting on "Modern Energy Supplies."

LOOK for the BIG IDEA—

RESULTS

Occasionally we run across a production man who has the impression that Fluid Packed Pumps secure better results only in wells producing viscous oil or where bad sand conditions are present.

The facts are different. Fluid Packed Pumps are handling a wide variety of pumping conditions—wells producing light oil and wells yielding heavy oil, shallow wells and deep wells, small volume wells and large volume wells.

Below is the record of a Fluid Packed Pump in a well producing light oil. It bears that familiar notation so frequently seen on records of Fluid Packed Pump operation—NO DOWN TIME.

Read This Field Record!

Date 9/20/35 Field [redacted]

*Company [redacted] Well No. 7

Pump Size and Type 3"x15" Positive Pull Fluid Packed Pump

Date Installed Nov. 14, '34 Tubing Depth 2800 feet

Gravity 41° Sand, Shale, Mud, % None

Avg. Daily Prod.—Gross 200 bbls. Net 200 bbls.

Length Stroke 34" S. P. M. 15 No Down Time

* Name of company on request

See the Fluid Packed Pump Section in the 1935 Composite Catalog . . . or write our nearest office for complete information.

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A MODERN PUMP FOR MODERN CONDITIONS

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C. F. Scott Heads Engineers' Council

Charles F. Scott, professor-emeritus of electrical engineering, Yale University, and chairman of the board appointed by Governor Cross to administer the recently enacted engineers' registration law in the State of Connecticut, was elected chairman of the Engineers' Council for Professional Development at the third annual meeting of that body held in New York, N. Y., recently. Professor Scott succeeds C. F. Hirshfeld, chief of research of the Detroit Edison Company, who has served as the council's chairman since its formation.

The Engineers' Council for Professional Development is a conference of engineering bodies organized to enhance the professional status of the engineer through the co-operative support of the national organizations directly representing the professional, technical, educational, and legislative phases of the engineer's life. The participating bodies are: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, American Institute of Electrical Engineers, Society for the Promotion of Engineering Education, American Institute of Chemical Engineers, and National Council of State Boards of Engineering Examiners.

George T. Seabury, secretary of the American Society of Civil Engineers, was re-elected secretary of the Council. New members of the executive committee also elected were C. F. Hirshfeld, representing the American Society of Mechanical Engineers; Harrison P. Eddy, of Boston, Massachusetts, past-president of the American Society of Civil Engineers, representing that society, and L. W. W. Morrow, managing editor of Electrical World, New York, N. Y., representing the American Institute of Electrical Engineers. Other members of the executive committee who continue in office and the societies they represent are: F. M. Becket, of New York, past-president, American Institute of Mining and Metallurgical Engineers; H. C. Parmelee, of New York, American Institute of Chemical Engineers; R. I. Rees, of New York, Society for the Promotion of Engineering Education, and D. B. Steinman, of New York, National Council of State Boards of Engineering Examiners.

New Plant Completed for Manufacture of DuPrene

The Rubber Chemicals Division of the du Pont Company announces that the new plant for the manufacture of its synthetic rubber, known as DuPrene, which has been under construction for the past year, is now completed and is producing at the rate of approximately one million lb. a year. The plant is at Deep Water, New Jersey, opposite Wilmington, Delaware, where all shipping facilities are available both by rail and water.

A. W. Burket Made District Manager Griscom-Russell Company

The Griscom-Russell Company, New York City, announces the appointment of A. W. Burket as district manager with offices at 20 North Wacker Drive, Chicago, Illinois, from which point he will supervise the company's direct sales and agency activities in the Chicago, St. Louis, Detroit, Milwaukee, and adjacent territories.

Burket, who until recently has been in business in Tulsa, Oklahoma, is well known in heat exchanger and similar equipment fields.

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TO MEET OPERATING CONDITIONS

Seat at any desired Point within TUBING

NOW—the newest B-M-W product, the B-M-W Admore Insert Pump Anchor permits of pumping from *any* desired level.

No common working barrel or seating device needed.

At all good Supply Stores.

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ANDERSON PHOTO-RECORD MAGNETIC SINGLE-SHOT SURVEY INSTRUMENT
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Where wells are to be kept vertical with inclination readings often less than one degree.

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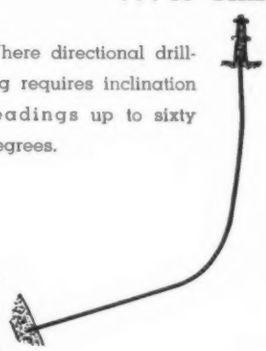

Because

. . a single instrument equipped with Anderson **Interchangeable Inclination Units** provides the closest possible reading of any inclination. The Units are supplied for maximums of 5°, 10°, 25°, and 65°.

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ALEXANDER ANDERSON, Inc.
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SURVEYORS OF OIL WELLS SINCE 1924

H. J. Lockhart, President Parkersburg Rig and Reel Co., Passes Away

Harold J. Lockhart, 60, president of the Parkersburg Rig and Reel Company, died at his home in Parkersburg, West Virginia, on October 20, following an illness of several months' duration. Death was attributed to heart disease. Born in Oil City, Pennsylvania, in 1875, Lockhart first entered the oil business there, but went to the Spindletop field in Texas in 1902 when that boom was at its height. Later he became associated with J. S. Cullinan in formation of the company that later became the nucleus of The Texas Company. When The Texas Company was formed he became purchasing agent for its production division, the Producers Oil Company. He was affiliated with The Texas Company until 1917, when he went with the Parkersburg Rig and Reel Company. About two years ago he was made president of that firm.

H. J. LOCKHART

He is survived by his widow, a son, Harold J. Lockhart, Jr.; a daughter, Dorothy Lockhart, all of Parkersburg; and a brother, W. E. Lockhart, who is in the oil business in Kentucky.

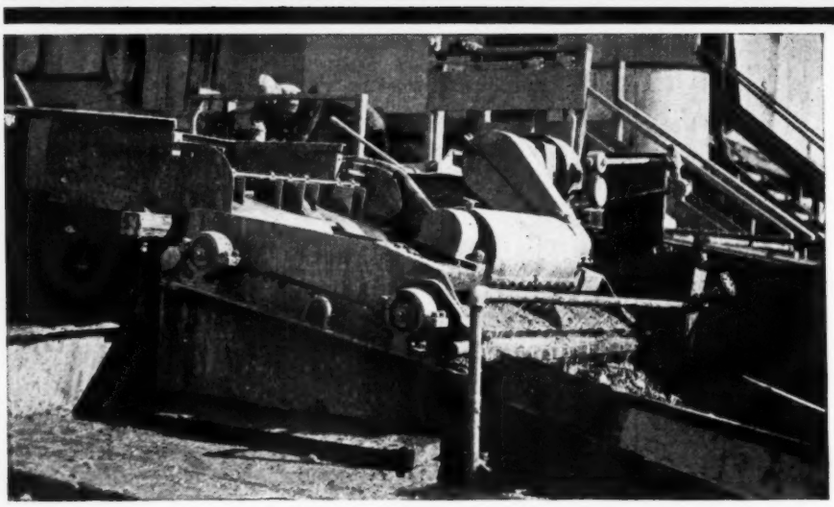
R. W. Howe Dies as Result of Car Accident

Ralph W. Howe, Dallas, Texas, vice-president and general manager of the Atlantic Pipe Line Company, died on October 23 as the result of an automobile accident which occurred earlier in the month near Huntsville, Texas. He suffered a fracture of the vertebrae when his car ran off the road and overturned. He was considered well on his way to recovery, however, when the lodging of a blood clot in the pulmonary artery caused death.

RALPH W. HOWE

Mr. Howe was a native of Hornell, New York, and a graduate of Cornell University. For a number of years he was an engineer for the Atlantic Refining Company and was in charge of the company's pipe line system in Louisiana. He moved to Dallas 14 years ago, when the Southwestern headquarters of his firm were transferred from Shreveport. He was active in affairs of the American Petroleum Institute and was chairman of the Committee on Standardization of Steel Tanks for Oil Storage.

DOES THE JOB *Right*



PERFORMANCE RECORDS in the field *prove* that the McNeely Vibrating Mud Screen "does the job *right*." Engineered and built to provide economical and dependable cleaning of rotary mud, this efficient and money-saving unit is the choice of experienced operators who know *values* in screening equipment.

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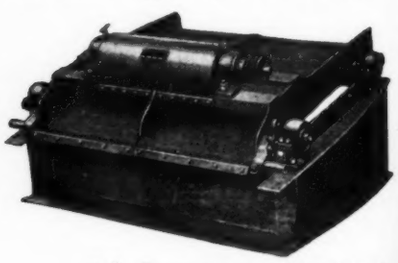


W. F. Rockwell Completes Business Trips

Colonel Willard F. Rockwell, president of the Pittsburgh Equitable Meter Company, the Merco Nordstrom

Valve Company of Oakland, California, and the Timken Companies of Detroit, has just completed a trip from coast to coast, visiting the various plants operating under his direction.

The rapidly expanding export business of these several companies has necessitated Colonel Rockwell's visit to South and Central America at this time. His return to the United States, via the Pacific Coast, is planned to enable him to attend the American Petroleum Institute convention at Los Angeles.

H. M. Humphrey With Union Rope

The Union Wire Rope Corporation has announced the appointment of of H. M. Humphrey as a member of their sales staff, to assist H. S. Frye in covering the Kansas oil fields. Humphrey's headquarters will be at Great Bend, Kansas.

The company's plant is at Kansas City, Missouri, and its executive and sales offices at Tulsa, Oklahoma.

E. M. Smith Co. Makes Appointment

R. S. Schermerhorn, widely known throughout the oil and oil equipment industry, has been made Mid-Continent representative for E. M. Smith Company, Los Angeles manufacturers of the Grizzly line of oil field products. His headquarters will be 5608 Junius Street, Dallas, Texas.

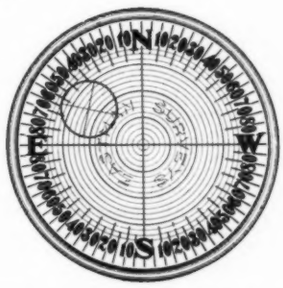
MR. OPERATOR . . .

Are You four feet from a
MILLION DOLLARS
or a Million Feet from
FOUR DOLLARS?

Try This Pair of
OIL FIELD NATURALS

They won't tell you that, but will tell you exactly what direction you're drilling and will put you back on the course you want to follow.

These EASTMAN tools, with EASTMAN methods, have made real underground history since development by EASTMAN of the Single-Shot Survey and Directional Drilling Service years ago on the Pacific Coast. Widespread acceptance by the Industry has made this helpful EASTMAN SERVICE available to the entire Oil World today.



Actual photograph recording the angle and direction of deviation, taken at any desired depth and available for checking within 5 minutes after the Single-Shot Instrument is run.

The EASTMAN SINGLE-SHOT INSTRUMENT . . which tells you at all times the exact location of the bottom of your well.

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Correspondence regarding any special need of pressure control will be given careful attention.

The Regulators here seen are in operation in a flowing plant of an active Oklahoma oil field

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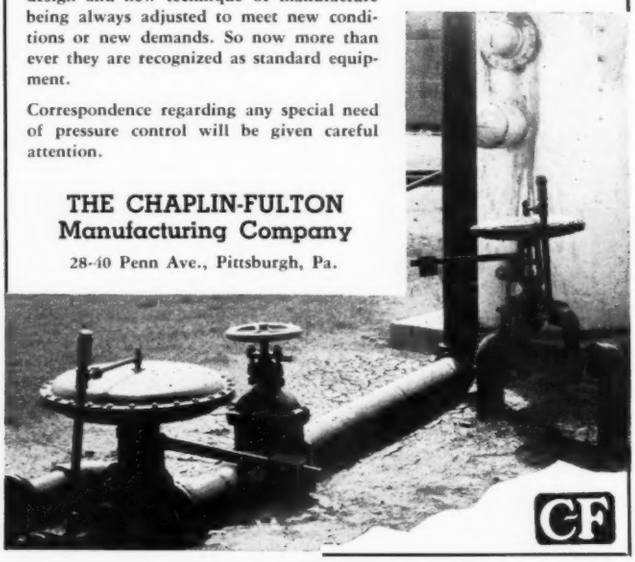

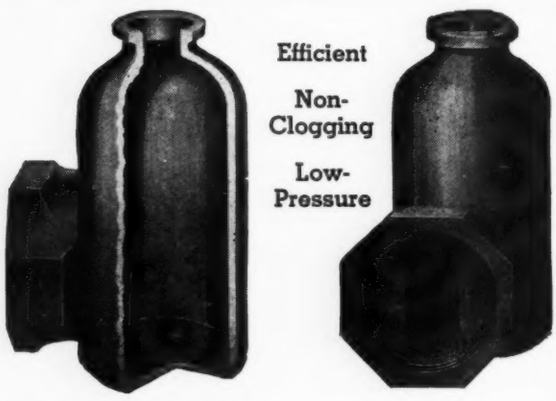

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PATENTED SPRAY NOZZLES

Lincoln Announces New Bulletin on Automatic Arc-Welding

"Automatic Arc-Welding by the Electronic Tornado" is the title of a new 42-page book announced by The Lincoln Electric Company, Cleveland, Ohio, manufacturers of arc-welding equipment.

The new book gives a full explanation of the "Electronic Tornado" system of automatic carbon arc-welding, developed by Lincoln for use in industries where products of relatively uniform character are produced in large quantities.

Described in the new automatic arc-welding book are such interesting subjects as: how the heat of the carbon arc is concentrated by the "Electronic Tornado"; how the carbon arc is shielded in automatic arc-welding; physical properties of welds made by the "Electronic Tornado"; how the "Electronic Tornado" simplifies automatic arc-welding, etc.

The various types of welds suitable for automatic welding are illustrated by line drawings and clearly explained as to application and procedure in the manufacture of widely varied products. Speeds and costs of making the various types of welds are tabulated in ft. per hr. and cost per linear ft. of weld.

Twenty-three pages are devoted to descriptions and illustrations of typical automatic arc-welding applications. Illustrations show the "Electronic Tornado" in use in the manufacture of automotive parts including mufflers, chassis frames, starter and generator frames, wire wheel hubs, rear axle housings and torque tubes; in the manufacture of pipe, steel barrels, steel drums, large tanks, small tanks and range boilers, steel cabinets, rectangular tanks, railway coaches, transformer radiator tubes, and barges. Illustrations and descriptive text are further clarified by diagrams showing details of the automatic welds.

In addition to explanation of the process and illustrated descriptions of its varied applications, the latest improved equipment for welding by the "Electronic Tornado" system is pictured and described.

The new book on automatic arc-welding is 8½ x 11 in., printed on heavy coated stock. Copies can be procured gratis from The Lincoln Electric Company, Cleveland, Ohio.

Hancock Valve Appoints Jobbers

The Hancock Valve Division of the Consolidated Ashcroft Hancock Company of Bridgeport, Connecticut, announces the recent appointment of the Moorlane Company and the Frick-Reid Supply Corporation, both of Tulsa, Oklahoma, as stock-carrying jobbers.

Malcolm Black has recently completed a four months' training course at the Bridgeport and Boston plants of the Consolidated Ashcroft Hancock Company and has been added to the Tulsa office of this company. Black has had several years of practical experience in and is well known to the Mid-Continent oil industry.

SPERRY-SUN WELL SURVEYING CO.

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UNDERGROUND WELL SURVEYING SERVICE

International Harvester Publishes Booklet on Safe Driving

Through what probably has set an all-time record for reprintings, millions of Americans have read in newspapers and periodicals the startling article from Reader's Digest entitled, "—And Sudden Death," by J. C. Furnas. A masterpiece of stark, unrelenting realism, recounting to the last terrifying detail the horror and suffering witnessed every day at scenes of highway smash-ups, the article has, by sheer shock, aroused the public conscience to the need for more careful driving.

As if timed for the receptive mood created by Mr. Furnas' article, a 64-page, pocket-size booklet entitled "I Drive Safely" has been published by the International Harvester Company for free distribution. It is available to all drivers of motor vehicles sufficiently interested in improving their driving to apply for copies. Hundreds of motor truck fleet operators already have applied to the International Harvester Company, 606 South Michigan Avenue, Chicago, Illinois, for copies for distribution to their drivers.

"I Drive Safely," a book of instruction for drivers of trucks and buses, is attractive in typography and illustrations, with terse treatment of its subject matter arranged under chapter headings for quick reference and review. It leaves nothing unsaid for any one seriously desiring to contribute to street and highway safety.

Pointedly illustrated for a ready grasp of safe driving fundamentals, some of the subjects treated are: speed, brakes, hilly roads, carbon monoxide, rules of the road, railroad crossings, safety loading factors, steering, tires, congested traffic, lubrication, slippery roads, vision, mechanical equipment, lights, pedestrians, garage accident hazards, and miscellaneous safety factors to which a separate chapter is devoted. Proper maintenance of the motor vehicle also is outlined in non-technical language.

Dedicated to the large number of truck and bus drivers who have exceptional non-accident records, a good many of these drivers are mentioned by name together with accounts of their driving records.

Publication of this educational booklet as an aid to safety campaigns conducted both by communities and private fleet operators was suggested by International Harvester employes whose objective is the elimination of industrial accidents and whose co-operative efforts have brought about an outstanding reduction in such accidents.

Among the early applicants for supplies of the booklet have been a number of police departments who plan to distribute the booklets in the interest of safer driving.

Statement of the Ownership, Management, Etc., of
THE PETROLEUM ENGINEER
October 1, 1935

(This statement is published in compliance with the Act of August 24, 1912).

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Editor: K. C. Sclater, Dallas, Texas.

Stockholders holding 1 per cent or more of total amount of stock: C. R. Barrett, W. T. Bryan, W. L. Love, Clarence Morris, K. C. Sclater, Dallas, Texas; J. L. Dwyer and Mrs. J. H. Dameron, of Tulsa, Oklahoma; Warren L. Baker, Houston, Texas; T. J. Crowley and F. R. Staley, New York, N. Y.

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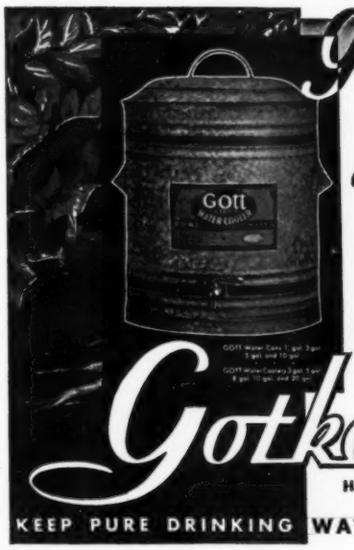
W. T. BRYAN, Secretary-Treasurer.

Sworn to and subscribed before me this 1st day of October, 1935.

S. HIGHTOWER, Notary Public.

(My commission expires June, 1937).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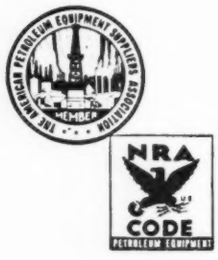

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